

QST

*A Magazine published by the
American Radio Relay League
and devoted exclusively to*
CITIZEN RADIO



APRIL 1922
20¢

Hyde Park
877



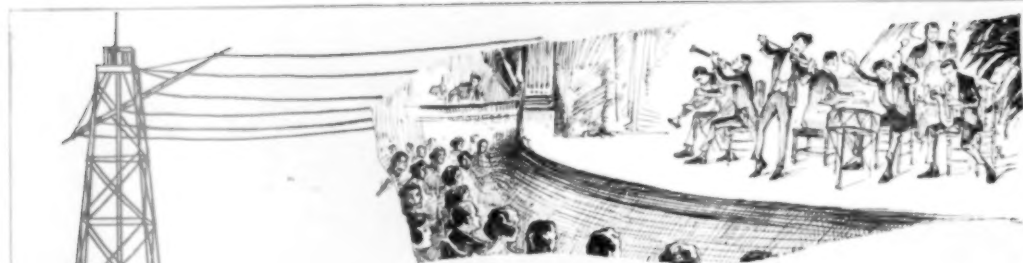
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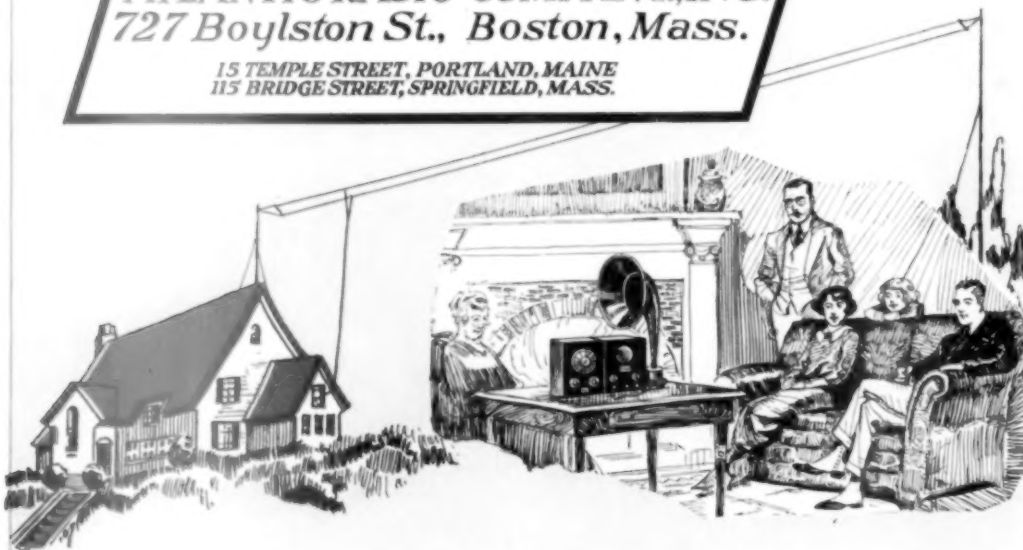
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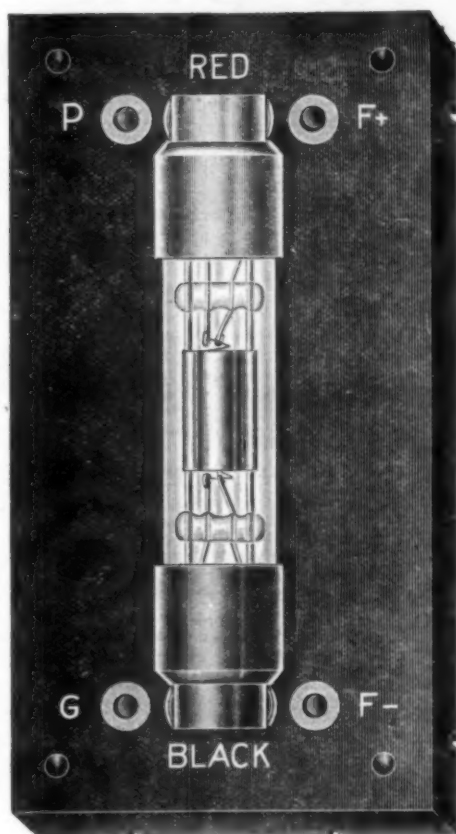
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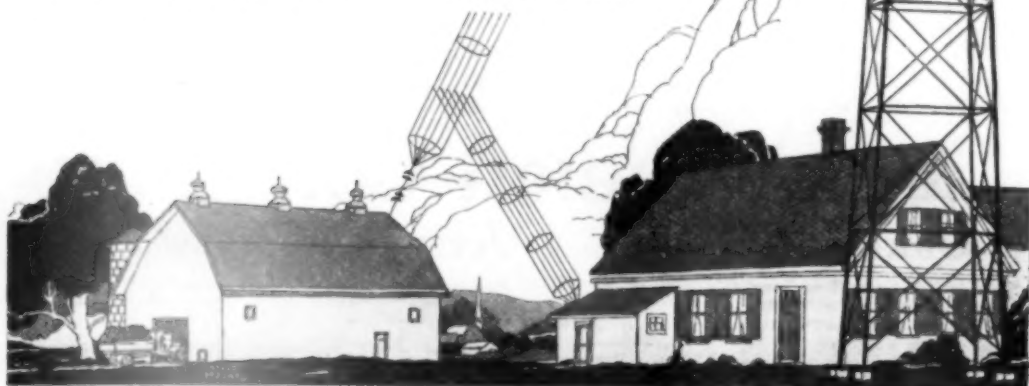
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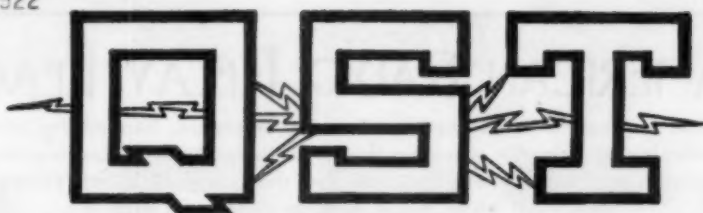
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THE AMERICAN RADIO RELAY LEAGUE, Inc.
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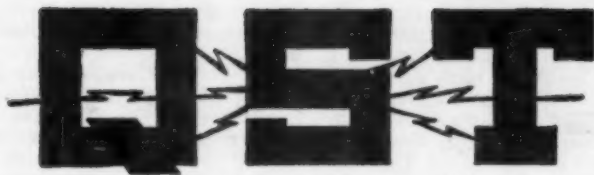
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A Magazine Devoted Exclusively to the Radio Amateur

The Washington Radio Conference

By K. B. Warner

AMATEUR radio has been recognized and honored in the first eight-day session of Secretary Hoover's Radio Commission. The Commission has recommended that a wave length band from 150 meters to 275 meters be allocated to amateurs and that this be specified in the new radio law; that this band be subdivided by the Secretary for the various classes of amateur transmitters, sparks on the shortest waves, then modulated C.W. (including self-rectifying C.W.), next radio telephones (including amateur broadcasts), and with straight C.W. telegraphy on the longest waves up to 275; and it has also recommended that amateur deputy inspectors be created whereby the amateur world may police itself and maintain observance of the subdivisions within the amateur band.

These are recommendations—they are not yet in effect. At this writing the Commission is in recess while a Legal Committee, of which Representative W. H. White, Jr., of Maine, is chairman, prepares a draft of an amendment to the present radio law which will make possible the changes in the regulation of all classes of stations, and it will meet again soon to study the new bill and give consideration to the comments received on its recommendations to date.

It was of course our good old A.R.R.L. which again represented amateur radio at Washington. Representatives of quite a few affiliated clubs were on hand to help, and they too of course are A.R.R.L. We wouldn't be surprised to hear about other folks who "saved the day for amateur radio" (after every scrap we do), but we're here to tell you that the A.R.R.L. was the only one on the job.

The Need

As everyone knows who knows anything

at all about radio, there have been dozens of attempts in recent years to revise the radio law of 1912, which is more or less outgrown technically and does not give the government sufficient regulatory powers to adequately take care of the greatly changed conditions obtaining in radio today. The past efforts looking towards new legislation have with one exception all been dismal failures because they did not make adequate provision for all of the classes of stations. The one exception was the Department of Commerce Radio Conference Committee of 1920, which examined the so-called EU-F-GB-I Protocol and finally drew up wave length allocations which were agreed to by every American radio interest and transmitted to the United States delegates to the Paris Technical Conference of last summer; at which latter meeting, however, the military interests dominated and a tentative international agreement was drawn up greatly at variance with the U. S. recommendations and promptly repudiated and discredited by all the civilian radio interests here when the Department of Commerce reported the results in November last. So that attempt, too, came to naught.

In recent months the radio game has progressed to a point where it simply cannot wait any longer for new regulations. The advent of broadcasting is the chief contributing factor. There are now well over a half-million receiving stations in the country, some sixty broadcasting stations, and rumor has it that there are some five hundred applications for broadcasting pending in the Department of Commerce. Obviously some discretion—some real horse-sense—must be used in issuing licenses of this type or conditions in the air will be entirely chaotic. Recently everyone has been talking about the efforts of the big corporations practically to control the air

for themselves, with the American Telephone & Telegraph Co., we understand, making an outright request for a monopoly on broadcasting! President Harding and most of his cabinet members have receiving sets now, and so have many congressmen and senators, and they are aware of these conditions. What was to be done about the situation? It was apparent that the law would have to be strengthened to give the Department of Commerce wide discretionary powers, with the authority to issue, amend or revoke regulations and licenses according to the trend of the art, endeavoring at all times to regulate radio so as to be of the greatest good to the greatest number of our people. And it was apparent that everybody could not be wholly satisfied simply because there aren't enough wave lengths, and that consideration would have to be given the importance of the different classes of stations and a study made of the possibilities offered by the available wave lengths. For this purpose the Secretary of Commerce was instructed to call a conference of radio experts to make a study of the situation and recommend principles to him for the governing of all of radio for the greatest good to the greatest number, keeping in mind the importance of the various services. He appointed to his committee Mr. H. P. Maxim, president of our American Radio Relay League; Dr. S. W. Stratton, director of the Bureau of Standards; Senator Frank B. Kellogg of Minnesota; Representative W. H. White, Jr., of Maine; Dr. A. N. Goldsmith, secretary of the Institute of Radio Engineers; Prof. L. A. Hazeltine, of Stevens Institute of Technology, Hoboken; Prof. C. M. Jansky, Jr., of the University of Minnesota; Mr. R. B. Howell, of Omaha, Neb.; Mr. E. H. Armstrong, of Columbia University; and one representative each from the War Department, Navy, Post Office, and Agriculture, who were, respectively, Major General Geo. O. Squier, Capt. S. W. Bryant, Mr. J. C. Edgerton, and Mr. W. A. Wheeler.

When this commission met in Washington on February 28th it was the most important radio body which had ever sat. We have every reason to hope that at last, after years of vain struggling, the radio situation is to be improved.

The first two days of the conference were given over to public hearings, at which representatives from all of the radio interests were present and given an opportunity to be heard. Then the Commission went into executive session, to formulate a plan by which the Secretary of Commerce can wisely administer radio regulation to the whole country, and to formulate a draft either of a new law or of an amendment to the 1912 law. Three committees were appointed, known as the Legal, the Technical and the Amateur Com-

mittee. Of the last-named, Mr. Maxim was chairman, with Mr. Armstrong and Professors Jansky and Hazeltine as members.

The Corporations Testify

The hearings were funny. First to be heard were representatives from the five big corporations whose association has caused the buzz of comment on the monopolistic conditions in the art. There was Mr. A. H. Griswold, vice-president of the A. T. & T. Co.; Mr. E. P. Edwards, of the General Electric; Mr. John Elwell, secretary of the Radio Corporation; Mr. L. R. Krumm, representing Westinghouse; and Dr. Nichols, of the Western Electric. In turn these gentlemen explained the attitude and the relations of their respective companies, told what they would like to have in new law, and made their recommendations for the general improvement of conditions. Now it seems that there is quite a bit of feeling in the air these days to the effect that the corporations are trying to hog things; that they have in effect a monopoly; that for that reason they won't sell equipment to competitors; that they could supply equipment a whole lot faster if they really wanted to; that they ought to be hung higher than Haman for the type of receiving apparatus they are putting out. In turn the gentlemen denied these charges, but they were so busy answering questions relative to these matters and the air was so charged with feeling along this line that the hearings rather took on the aspect of a Congressional Board of Inquiry!

Mr. Griswold testified that the A. T. & T.'s only interest in broadcasting was to sell toll broadcasting service. In response to inquiries he stated that his company would sell transmitting equipment for broadcasting in connection with the purchaser's own business or for public service broadcasts. He explained the patent situation by describing the agreement made between A. T. & T. and G. E. at the request and approval of the government, for the merger of patent rights, the A. T. & T. retaining all commercial applications of the radiophone, the General Electric the amateur radiophone business and all classes of radio telegraphy. Radio Corporation and Western Electric entered later as an extension—it was agreed that G. E. might extend any of its rights to the Radiocorp and that the A. T. & T. might extend any of its to W. E. Still later, Westinghouse made an agreement with General Electric and entered in, Mr. Griswold said, A. T. & T. consenting.

Mr. Edwards thought that commercial broadcasts ought to be confined to daylight, with only entertainment in the evenings. In general, he favored control of broadcasting by big corporations and the government, and rather thought jazz should have

precedence over crop and market information, suggesting that the latter, for economy's sake, should be put out by entertainment broadcasting stations. Answering inquiries, he stated that Westinghouse and General Electric manufacture equipment under licenses from Radio Corporation, which is cross-licensed in turn. Radiocorp is the only one who can buy Westinghouse and G. E. apparatus, and must sell those makes only. He volunteered the information that General Electric were themselves manufacturing receiving apparatus and would have a line of complete sets on the market very soon, which he thought were of the single-circuit type. He stated that by the latter half of March their tube production would be between fifty and sixty thousand per month; that they manufacture tubes only on order from the Radio Corporation but that they are now being made at three times their former rate.

Mr. Elwell, secretary of the Radio Corporation, made a good clean-cut statement, suggesting that stations be classed in the order of their importance as follows: government, civil departments, maritime, educational, entertainment, amateur, public service. He thought legislation should safeguard life at sea and the future of the amateur. He put his company clearly on record as favoring the recognition and encouragement of the amateur. He asked permission to file a statement for the benefit of the commission, explaining the patent situation, the relations between the companies with which his was associated; the policies in the sale of apparatus, etc. The testimony of his company on these subjects accordingly was never public property. Unfortunately Mr. Elwell could answer practically no questions, particularly along this line, and in every case stated that the answer to said questions would be contained in the statement he wished to file.

Mr. Krumm, assistant sales manager of Westinghouse and in charge of their broadcasting stations, objected to the interference that anybody's five-hundred dollar limited commercial broadcasting station could cause to Westinghouse's \$15,000-stations. He thought twelve to fifteen broadcasting stations would be enough for the country, and proposed the band from 300 to 400 meters for them.

Dr. Nichols of course is a scientist, and knew his subject technically, in marked contrast to the other gentlemen. Testifying for Western Electric, Dr. Nichols thought fifteen good broadcasting stations enough for the country, and thought they logically ought to be on shorter waves because of the greater "cyclage" there. On the other hand, he thought the more important subject was ship-to-shore radiotelephony, and as several bands were desirable for that and there was objection to it being raised to a point over 1000

meters, he thought the broadcasts could very well be raised instead.

Mr. Cooper, of the Ship Owners Radio Service, proposed subdivision of amateur services over a band from 200 to 350 meters and a similar sub-division of commercial phones, advertising broadcasts on 400 meters, general entertainment broadcasting, etc., 1500 to 1700; and commercial telephony from 900 to 1200. Hurray for Sorsinc.

Mr. Max Loewenthal, of San Francisco, representing the Pacific Radio Trade Assn., told the committee of the schedule of time divisions satisfactorily employed on the West Coast, and that they there would welcome government regulation.

Amateurs Are Heard

Thus ended the first day. On the second morning amateur representatives were heard. They were represented by an A.R. R.L. delegation composed of Paul F. Godley, Vice-President Chas. H. Stewart, and Secretary K. B. Warner. Again that paragon of radio amateurs, Paul Godley, rendered a valuable service to the game—he very splendidly presented the case of the amateurs: their need for a band of waves versus a fixed limiting wave length; the desirability of subdividing the band for the different classes of stations; the need for grading amateur operators into two classes, with beginners on a different wave length, etc. He pointed out the fact that most of the trouble broadcast listeners have been experiencing thru interference has been due to the wretchedly broad-tuning receivers that have been supplied them in the belief that they are incapable of mastering a modern tuner, and in particular called the attention of the Secretary to the publicity that in recent months has appeared in the press characterizing the amateur repeatedly as "the American small boy" and saying that he must be curbed because he was interfering with everything, etc. This publicity has been so consistent, so much along the same line wherever it appeared, that in the minds of many amateurs it is considered as inspired propaganda from unfriendly interests. Some of these newspaper items have attempted to put the Secretary in the position of saying that the amateurs must be curtailed, but we want to tell the world that Mr. Hoover has spoiled all that stuff for all time henceforth. Here is his reply:

"I would like to say at once that anyone starting any such suggestion that this conference proposes or had any notion of limiting the area of amateur work was simply fabricating. There has never been any suggestion of the kind, never any discussion of the subject in any shape or form. The amateurs were asked to be represented in the conference and they are represented here today, and the starting

of that sort of information is one of the most treacherous things that can be done. So I wish to sit on that right at the start—that the whole sense of this conference has been to protect and encourage the amateur in every possible direction."

Newspaper propaganda to the effect that the amateur—"the American small boy"—is an infernal nuisance and must be "curbed" has been noticeable by its absence since the Secretary's statement. Flock o' Hi's!

A.R.R.L. Secretary Warner followed Mr. Godley in the witness chair and was also heard in the interests of the amateurs. In common with the rest of the amateur delegates he particularly urged that the commercial broadcasts be placed on a band above 1000 meters, where interference from ships and the occasional conflicts with local amateurs that will be practically unavoidable as long as novice listeners use single-circuit tuners would be minimized, pointing out that the present broadcast wave of 360 meters could only be regarded as an invasion of what has always been regarded as the amateur realm—up to 375 meters. Vice-President Stewart followed, supporting the same views, recommending 325 to 425 meters for ship-to-shore telephony, and showing from a study of the current International Convention that there is nothing to prevent the United States from placing the commercial broadcasts on a higher band, say above 1000 meters.

Representing independent commercial companies were Mr. Perry E. Wiggan of the Radio Electric Co., Pittsburgh; Mr. L. F. C. Horle, of the Federal Tel. & Tel. Co., Buffalo; Mr. Thompson of the DeForest company; Mr. H. J. Breckel of the Precision Equipment Co., Cincinnati, etc. All of these men had a good word to say for the amateurs, particularly Mr. Wiggan, who of course is our A.R.R.L. City Manager for Pittsburgh and also represented the Radio Engineering Society (affiliated) of that city.

Then came representatives of various interests who were concerned with radio-telephony—The New York Public Service Corporation, the Philadelphia Police Department; the "Detroit News", the National Retail Dry Goods Assn., the U. S. Shipping Board, the Boy Scouts, the Public Health Service, etc., each presenting his side of the story. Several sharp skirmishes took place between conflicting interests, generally with the oft-referred-to corporate interests on one side of the fence. It was good in spots. Regardless of the truth of the statements or the possibility of proving them, almost everybody except the representatives of the several big companies seemed to feel that a monopoly of radio did exist, far beyond that contemplated by the separate patents granted them; that they were earnestly endeavoring to hog the whole

air and deliberately fostering discontent where it helped their interests; selling apparatus only where they wanted to and holding down their competitors even when they couldn't make apparatus fast enough to supply the public need in a field that must be regarded as a public utility, etc. They got raked over the coals in high fashion and spent considerable of their time on the defensive, which it was obvious they had not contemplated when they arrived at the conference. Good judgment prevailed in the Commission, however, and the big companies should be well satisfied with the provisions recommended from their uses.

The Commission's Recommendations

Finally the hearings were over and the Commission went into executive session. It was the Editor's good fortune to be permitted to attend the meetings as advisor to Mr. Maxim and he only wishes that it were permissible to tell the gang all the interesting talk that went on, but the deliberations of course were confidential. The big plan is that an amendment is to be proposed to the 1912 law, giving the Department of Commerce wide discretionary powers in classifying stations and assigning wave lengths, powers, operating hours, etc., for each of the various classes. The principal duty of the Commission was to outline guiding principles for the administration of radio for the greatest good to the greatest number—in other words, to recommend to the Department what it should do when it received the wider authority now universally recognized as essential to it.

First off, the Commission divided broadcasting into four classes, as follows:

Government—meaning material of national interest, to be broadcasted from government stations of about 600 mile range. Public—meaning material of general public interest (informational and educational services) such as market and crop reports, weather forecasts, health services, etc., as might be broadcasted from University stations, etc., normal range to be 250 miles.

Private—meaning the broadcasting of entertainments, news, etc., by the owners of such stations as the Westinghouse ones, etc. This is the big popular class. Normal range, 50 miles.

Toll—meaning transmissions from such stations as contemplated by A. T. & T. at present, which will be leased for the broadcasting of entertainment, news, etc., under toll. Range, 50 miles.

The recommendations of the Commission have now been made public by the Department of Commerce. They make the following proposals for the disposition of various wave lengths:

Below 150 meters—reserved.

- 150 to 275 meters—Amateurs.
- 200 to 275 meters—Technical and training schools.
- 275 to 280 meters—City and State public safety broadcasting.
- 310 meters—Restricted special amateur telegraphy.
- 310 to 435 meters—Private and toll broadcasting.
- 500 to 525 meters—Aircraft radio.
- 525 to 650 meters—Mobile radio telegraphy.
- 650 to 750 meters—Mobile radio telephony.
- 700 to 750 meters—Government and public broadcasting, 700 miles inland.
- 750 to 850 meters—Radio compass.
- 850 to 950 meters—Aircraft radio.
- 950 to 1050 meters—Radio beacons.
- 1050 to 1500 meters—Government and public broadcasting.
- 1500 to 1550 meters—Aircraft radio.
- 1550 to 1650 meters—Fixed station telephony.
- 1850 to 2050 meters—Government broadcasting.
- 2500 to 2650 meters—Mobile radio telephony.
- 2850 to 3300 meters—Fixed station telephony.
- 5000 to 6000 meters—Transoceanic telephony.

Amateur Provisions

The following recommendations of the Commission relate directly to the amateur proposition and are of the highest interest to us amateurs:

"That the status of the amateur be established by law.

"That the limits of the wave length band allocated to the amateur be specified in the law.

"That the wave length band allocated to the amateur be from 150 to 275 meters.

"That the Secretary of Commerce subdivide the amateur allocation into smaller wave length bands for the various classes of amateur transmitting apparatus, at his discretion but in the following order of wave lengths, starting at the shortest wave: spark, interrupted or modulated continuous wave telegraphy, telephony, continuous wave telegraphy.

"That for the purposes of self-policing among the amateurs, amateur Deputy Radio Inspectors be created, elected from their number by the amateurs of each locality, every licensed amateur having the right to vote; that upon receipt of notice of such election the Radio Inspector in charge of the district in which such amateurs are located shall appoint the person chosen a Deputy Radio Inspector, serving without compensation or for the sum of one dollar per year if compensation is legally required; that the duty of such Amateur Deputy Inspector shall be to endeavor to the best of his ability to accomplish, under the direction of the District Radio Inspector, the observance by amateurs of the Radio Communication Laws and Regulations of the United States and the observance of such local co-operative measures as are agreed to in each community for the minimization of interference between the various groups of the public interested in radio; that such Amateur Deputy Radio Inspectors be clothed with whatever authority may be necessary in the opinion of the District Radio Inspector."

The Commission urged that the present regulations governing experimental stations remain in effect, and regarding amateur broadcasting it was recommended that amateurs be permitted to carry on broadcasting within the wave length band assigned by the Secretary of Commerce to amateur radiotelephony. Plainfield, (N. J.) papers please copy!

The special restricted amateur wave of 310 meters is for use by a limited number of inland stations and only where it is necessary to bridge large, sparsely-populated areas or to overcome natural barriers.

There was considerable talk at the hearings about the abolition of the amateur spark. While QST has consistently boosted C.W. in the knowledge that it was the real stuff, it subscribes heartily to the sentiment expressed by all the amateur representatives at the hearings, which views were shared by many others; namely, that the prices on C.W. apparatus, particularly tubes, are entirely too high at this time to justify any such thing as a law forbidding spark, which would require that every station owner purchase tubes and other apparatus from the one combination of companies controlling all the patents, especially when the patent-holders cannot supply the demand nor do they license other companies to manufacture these products. Everyone seemed willing to admit, however, that when good C.W. apparatus and tubes became widely available at decent prices, the amateurs would be willing to forsake the spark upon reasonable notice. Thus we find the Commission recommending "that the Secretary of Commerce at his discretion prohibit at any time the use of existing radio transmitting apparatus and methods which result in unnecessary interference, provided that such action should not be taken unless more satisfactory apparatus and methods are commercially available at reasonable prices and until an adequate time interval is allowed for the substitution of the more satisfactory apparatus."

The Commission likewise gave much attention to the radiating proclivities of autodyne receivers, particularly of the single-circuit type where the oscillating antenna

current may be quite appreciable, and adopted a recommendation very similar to the above paragraph respecting spark and arc apparatus only this time applied to the use of existing radio receivers which cause the radiation of energy.

Broadcasts Not Raised

The Commission was unable to see the practicability of putting the last two classes of broadcasts on a higher wave, say above 1000 meters, as seems so very desirable; not out of consideration for the short-wave receiving apparatus now in existence but from a purely technical consideration. A radio telephone requires a band of cycles, as everyone knows. Possibly 10,000 cycles is a fair estimate of what is required for a decent phone. This puts it strictly on a basis of "cyclage", and the more the cycles the more phones that can be operated in a given band of wave lengths. Thus there is room for less than a dozen phone waves in the whole band from 1050 to 1500 meters, whereas something over two dozen can be accommodated in the much small wave-length band from 310 to 435 meters. Up to this writing, then, we have failed in our desire to get the broadcasting raised to a higher wave, and it seems likely that we will continue to have it as a next-door neighbor. This means that we amateurs have an educational job on our hands, and it is going to be up to us to convince our listening-in neighbors that there are lots of other sources of interference than our transmission.

The Commission has recommended that the status of the amateur be specified in the law, that is, that he be named as one of the classes of stations which shall always be established by the administration, and that the amateur wave length allocation, 150 to 275 meters, be specified in the law. This we regard as essential—for a thousand reasons. We have to thank our present guarantee in the 1912 law for our present existence—several times we would have gone up the flue if it hadn't been impossible to abolish us without changing the law, which is always a hard matter. With waves reserved below us, and the broadcasts clamoring above us, big combinations lobbying at Washington for more

cycles and our existence based purely on temporary classification of the Department of Commerce, subject to fluctuation by official proclamation, we'd be in a sweet pickle. The fact that the biggest broadcasting field is to continue right above our heads where some conflicts with the novice public are unavoidable, with their consequent unpleasantness and embarrassment and complaints to the government, etc., is the big reason why we amateurs must all insist that we get our guarantee of continued existence written right into the law as it is at present. The present Secretary of Commerce and our good Chief Radio

Inspector, Mr. Terrell, are splendid friends of the amateurs, but some day somebody else may be in their respective offices and the amateur future might be worth about two cents. Altho contrary to the plan of the proposed amendment which would leave the specification of classes and wave lengths subject to change at the discretion of the Department, we feel that an exception can be made with propriety in the case of the amateur because his wave

length band is at one end of the spectrum and his province can be defined and all other frequencies left subject to change without disturbing the operation of the scheme. This has an added advantage in stabilizing the use of the frequencies near us, for what company would want to put their millions into equipment that might be made junk of by sudden shift in the amateur wave?

We must have our status written into the new law. Remember that, A.R.R.L. men, whenever you see a copy of a new radio bill, and be governed accordingly

The proposed allocation of 150 to 275 meters to us amateurs, sub-divided among our various classes of transmitters, will make a wonderful improvement in our operating conditions, where we already have some 15,000 transmitting stations; and with government approval of our A.R.R.L. scheme for self-policing, we can look forward to sunny prospects in the amateur world.

President-Governors' Relay Succeeds

IN spite of terrific atmospheric conditions over almost the entire country on the first two nights of the tests and widespread unfavorable conditions on the last night, the President-Governors' Relay was a success and a total of forty out of forty-eight messages were delivered to the White House.

A couple of the messages seem to have been unable to get out of their home state, and a few of the Democratic governors couldn't see the joke and declined to furnish a message to the Big Chief.

A complete story of the Relay, with texts of the various messages and dope on who handled them, will appear in the next QST.

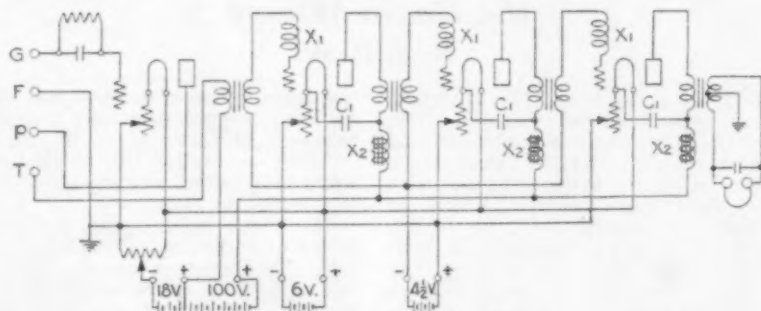
Improvements In Multi-stage Audio Amplifiers*

By H. E. Bussey, 4AI

IT is not the purpose of this paper to claim any discoveries, or to take to the author any credit for the results secured by the application of the measures which will be described—probably some of them are known to you. I am indebted to various Engineers in the Research and Radio Departments of the General Electric Company for the suggestions which have vastly improved the operation of the audio amplifier in my case.

Local noises and lack of expected amplification per stage have not, prior to the advent of so much telephone reception, been as objectionable as it is at present. If we may improve the amplifier so that the same results can be accomplished with fewer stages, then we have gained a decided advantage in both economy and ease of operation.

In order to prevent interaction between stages, it is proposed that thorough shielding be used for both magnetic and static effects, and to completely enclose each stage as well as the detector on all sides, top and bottom, with a 1-16 inch sheet steel shield. An amplifier was built unshielded with provision so that shields could be applied to see what, if any, difference could be noted. Without the shields in place, two stages could be operated, but with far less amplification than should be expected. Three stages were not possible due to howl and other noises. Shields as described were put in place, the inter stage wiring being carried through slots in the inter stage shields, and the improvement was remarkable. The shields and transformer cores were connected to the positive end of the B battery. The shielding was certainly a step



The ideal amplifier is one which in each stage takes the signal from the preceding detector or stage, and without reacting in any way on the preceding stage, repeats what is delivered to it and amplifies it as much as possible without distortion before delivering the signal to the next stage. Troubles are experienced in attempting to do this from electromagnetic and electrostatic reaction of one stage on another, if measures are not taken to prevent it. Added to the reaction between stages local oscillations may start within a stage and tend to upset the amplification constants of the tube. These oscillations may apparently be of very high frequency, and if so, may not be audible, or may be of the audible frequencies and result in the well known howl so familiar to all of us.

in the right direction, but all interaction was not eliminated even by this means, as a certain amount of coupling back still existed through the common plate battery. In order to overcome this an iron core choke, X_2 , was inserted in the plate lead of each stage and a 1 mfd. condenser, C_1 inserted as shown in the diagram. The improvement at this point was very great—three stages working much quieter than two had before and signal audibility per stage very nearly doubled. The quality of telephone speech also seemed much clearer. The iron core chokes consist of the 110 volt winding of a standard bell ringing transformer. This choke as well as the condenser is installed inside the shielded case of the stage to which it belongs.

The complete shielding of the transformers alone was tried first, but that did not seem to effect noticeable improvement. The

*Read before Third and Fourth District Convention February 17, 1922.

filament rheostats, tube sockets, wiring, etc., all seem to be a source of troublesome coupling back.

A further refinement has been added to lessen the possibilities of the tubes oscillating at very high frequencies as previously mentioned, in the form of radio frequency chokes, X_1 , consisting of 25 turns of No. 30 DCC wire wound in a single layer on a wooden form 1 in. in diameter. These are inserted on the tube socket and connected in the grid lead of each tube.

In audio amplifiers of several stages the miscellaneous popping and grinding noises sometimes present are from a variety of causes, but the majority of them are eliminated by the foregoing measures. Some of the more common ones not eliminated are bad contacts at any point. All joints in wiring should be soldered securely. Dry cells run down are unsuited for use in plate circuits. Several good dry batteries are now on the market designed for a minimum of such disturbances. Poor contacts in fila-

ment circuits, such as poorly designed rheostats and storage cells in bad condition, also cause noises. Much has been said of the necessity of good B batteries, but of equal importance are the filament battery and filament connections, as some of the most objectionable noises come from this source.

Loose contacts in tubes and tube sockets, and poorly made grid leaks should also come in for inspection and elimination.

For those who wish still further refinement, the use of an output transformer is recommended. This transformer permits the use of any ratio of tube impedance to phone impedance desired, by change in transformer design and permits the use of more rugged low resistance phones than when used directly in the plate output circuit. An added advantage is that the center point of the transformer secondary may be grounded and minimize the objectionable coupling back from the operator wearing phones, to the tuning element.

"And It Came To Pass"

The Episode of the Much-Married Ham and the Radio Widow

By S. P. W.

AND it came to pass that a certain dial-twirler reached the age when shaving becometh a nuisance and not a novelty, and the latest dance step arouseth more interest than Einstein's theory of relativity, and as is the habit with young men, he falleth in love. And lo, as time passeth, he confuseth osculations with oscillations, and spooning with tuning, and his spark no more roareth thru the ether, or whatever the latest theory contendeth that sparks roar thru. Yea, he disappeareth from the list of "Calls Heard," and his friends wonder.

In the fullness of time he asketh HER the fatal question, and she accepteth him. The final Hook-up is consummated, even as it is ordained, and the couple go forth on their honeymoon and they shed rice and smiles as they go, for such is the custom.

But on the nineteenth day thereafter, they return to the home town, and take up their residence in Bungalow Row. And lo, no sooner do they return that he erecteth a pole in the back-yard, and fixeth a staff to the ridge-pole. And in the course of time an aerial swingeth; lo, it is complete even unto a lead-in and ground.

And his wife asketh him wherefor, saying "Why stringest thou those wires?"

"Why clutterest thou up the attic with junk?"

"Why poundest thou so on divers con-

traptions, whereof I know not the name?"

"Why bringest thou thy friends to track thru my perfectly clean house?"

"Why——" But list to thine own wife when thou takest one unto thyself, for each inquireth the same.

He trieth valiantly to explain the mysteries of radio; he persuadeth her to enter into the operating room. But she crieth out when the spark crasheth in the gap; she claimeth that the cans hurt her ears, that the head-band pulleth her hair, and other heresies. She complaineth that the buzzing of the sparks giveth her headache; she seeth no good in radio, and departeth downstairs. And it was so for years, even to the number of the fingers on one hand.

The war cometh and goeth, and the aerial and set goeth and cometh back, as was ordained in Washington. And with the return of the set cometh strife. Our hero's wife setteth down her foot; she saith all manner of harsh things against radio. She beggeth and pleadeth, she threateneth to return to the domicile of her maternal parent; she doeth all manner of things to prevent the return of radio in her household.

She saith unto him, "My lord, I wish not to be even as the wives of the golf bugs, and to be called a 'radio widow,' for radio taketh up thy evenings, and maketh

thee to neglect thy wife. Thou speakest of regenerators in thy sleep, yea, thou mutterest and groanest and cursest QRM. Thou comest to bed in the small hours, and wakest me to rave of DX. Of my past experience do I know that thou makest of radio a nuisance and an abomination; surely this thing shall not be!"

Yet the aerial did blossom forth again, and the old set cometh to light. And in the course of time, a new set assembleth itself, and five-watt tubes glow where the spark was wont to crash, for wherefore can a set be modern, and yet use a spark? His wife sulketh and gnasheth her teeth, and extracteth much largess in the form of flowers, sweets and knick-knacks ere she cheereth up.

But the set endureth; it was, and is, and always shall be, for when the bug biteth, he biteth deep; the virus pulseth to the far parts of the body and sinketh in; even matrimony faileth to eliminate it.

Time passeth, even as it is wont to do, and lo, it worketh wonders; a miracle is wrought in the household of our friends. For Ye Editor insisteth upon a happy ending, and how can anything be happy when thy wife hateth thy hobby, and stirreth up strife accordingly? Yea, a miracle is needed, and behold, it is chronicled in this wise.



The time cometh when the phones fill the air with sweet noises (provided only that their modulation be good!) and our hero thinketh unto himself "My storm and strife loveth music, else why runneth she me in debt for a Victrola, and why carteth she home numerous records therefor?"

And he reasoneth further "An it be she loveth music, why loveth she not radio? For it has come to pass, even as the singer of old hath predicted, that 'our nights shall be filled with music, and the cares that infest the day shall collapse like a trick loose-coupler, and silently fade (we'll say they "fade"—ED.) away,' or words to that effect." And he pondereth much on the matter, till he decideth upon a plan.

The next night he bringeth home the

Magnavox that belongeth to the Club, and he borroweth two extra stages of amplification. He departeth immediately from the dinner table, and ascendeth to the radio shack. He hooketh up his instruments cunningly, he lighteth his tubes even unto the fourth step. He testeth exceedingly, and looketh frequently upon his watch until it be the time for KDKA to start.

Then he switcheth in the Magnavox and openeth all the doors. He tuneth for the carrier wave, and findeth it. The shriek soundeth throughout the house, being amplified exceedingly, and he heareth with falling heart the reproaches of his wife. At last soundeth the voice of the operator, as he announceth a selection by an orchestra of much note, (wherein no pun is intended) and our hero chuckleth unto himself, and brighteneth up his tubes.

And lo, in a second the sweet sounds of the orchestra burst forth most powerfully, and the lilting strains fill the house. It is good radio weather, and the static QR Neth not. Our hero sinketh back in his decrepit armchair, and thinketh good thots of everything and everybody saving three "5" stations that QRM on 360 meters.

And it came to pass, even as he had planned, that his wife rusheth to the radio room, and registereth joy and amazement. She listeneth with rapture to the smooth voice of KDKA announcing a tenor solo, and closeth her eyes dreamily at the love song she heareth.

And then she bombardeth her husband with questions, saying, "Why hast thou not told me of this wonder? How cometh it that we hear sweet sounds, when we used to hear only trick buzzes? Whence cometh this music?" and divers other things.

He answereth her with dignity, saying "In the past hast thou spoken all manner of evil things falsely against radio, so I gathered that thou wouldst not be interested!" And he assumeth an expression of wounded pride, and registereth indifference.

But she, being wise in the ways of men, as are all women, saith unto him sweetly, "How marvelous of thee, my lord, to operate these instruments! How wise art thou to master all this junk! My man art thou, and truly, I am proud of thee!"

And he acteth, even as would thou and I, like unto the small boy praised in front of the class by the teacher, and he saith, "Aw, it is a simple matter! Thou tunest with this dial, and regeneratest with this" and he suiteth the action to the word, and showeth her much. He explaineth all things unto her, and teacheth her to operate proficiently. Her sensitive woman's fingers learn easily the accurate adjustments, she comprehendeth the functions of the rheostats and learneth even to forget not to throw the lightning switch.

And it came to pass that night that the

Radiofonus Fanerii, a bug of the genus Radio, did bite the wife of our hero, and she exhibiteth the usual symptoms. She studieth catalogs and catalogs and diggeth into old radio magazines. She maketh salad



dressing with transformer oil, and baketh pieces of wire and calleth it macaroni au Marconi. She cutteth doughnuts on a spiral and frieth them into O.T.'s. She substituteth a call book for the cook book, and taketh out a membership in the A.R.R.L. She joineth the Radio Club and delighteth in the title of "OW." She learneth the Code, and becometh a regular ham; her

husband exulteth exceedingly, and saith unto himself "This is my work!" and he is much puffed up.

* * * * *

For his birthday she giveth him two steps of amplification and for Christmas a Magnavox of his own, and evenings she sitteth on the arm of his chair and whistleth "D-o y-o-u l-o-v-e m-e?" and he whistleth back; "dit-dit-dah, dah-dit dah-dah-dah, dit-dit dah!" and rejoiceth exceedingly. Which maketh the happy ending that Ye Editor hath insisted upon.

(As a matter of fact, our hero's wife told him just the other day that he shouldn't spend another cent for that darn-fool radio set till she got a new coat and a new hat that Lord knows she's needed for a year, and that she couldn't see why on earth a grown-up man wanted to monkey around with that sort of thing, and why didn't he—but there! You married hams will get me, and the single ones will never understand till they go thru it, so why continue with the harrowing details? You've had your happy ending, anyway!)

Improving Antenna Efficiency

By M. B. West

Every time Mr. West writes an article he "starts something". Probably this is some more of the same. It is especially commended to the power-factor sharks of last season's discussion. This paper has been prepared with care and its arguments regarding power-factor are supported by Prof. J. H. Morecroft in his latest text-book. Personally we do not subscribe to all of it and it is unpleasant to have all of one's radiation theories completely upset, but the subject-matter below and the manner of its handling will start every one of us to thinking—and that means progress. With knowledge of what we are doing, then, and wishing it understood that we haven't decided whether to believe this or not, we prayerfully present Mr. West's latest.—Editor.

THE "riot," which was with so much difficulty just barely averted by the timely and vigorous use of the gavel by Chairman Mathews when the subject of "power factor" was brought up at the technical meeting at the Chicago Convention, demonstrated one thing to me very clearly. That was the seeming fact that no one really understood exactly what happened in a simple oscillation circuit, or, if any one really understood, no one seemed able to tell. And, if there was so much difference of opinion concerning the action of the one fundamental circuit on which all radio work is based, it must of necessity follow that much of our work was, relatively speaking, "in the dark," and the question was of more importance than really appeared at the time.

While it is not the purpose of this article to re-open the discussion on power factor, the question of what really happens in an oscillatory circuit is of such importance that an explanation will, of necessity, refer to the subject.

Fortunately, "Principles of Radio Com-

munication," 1921, by J. H. Morecroft, devotes considerable space to the subject, and, insofar as I am able, I will follow the explanation given by him without the mathematical formulae. We will first consider a simple oscillatory circuit, Fig. 1, which may be considered as the closed circuit of a spark transmitter, the gap being replaced by a switch. Assume that the condenser is charged to a given potential, which is shown as point (a) in Fig. 2. If the switch (S) is now closed, current will immediately begin to flow through the inductance (L) and resistance (R), and will be represented by the solid line in Fig. 2. While flowing, the current will build up a magnetic field in the inductance (L). Quoting Morecroft, "The maximum current occurs one quarter of a cycle after closing the switch, nearly." The effect of the resistance is to make the current greatest shortly before the quarter cycle is reached. "Now this could have been predicted from the consideration of energy in the circuit: before the switch is closed all the energy is in the condenser." "One quarter cycle after

closing the switch the voltage across the condenser is zero so all the energy must be in the coil." The current flowing through the coil has set up a magnetic field around the conductors and as this field collapses it generates an electromotive force in such direction as to maintain the current flow,

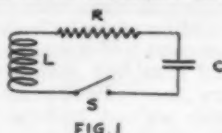


FIG 1



FIG. 2

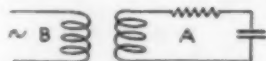


FIG 3

and current continues, this time charging the condenser in the reverse direction until we have at one half cycle zero current again and again a potential across the condenser. In other words, the energy is back in the condenser again, with the difference that the plates that were charged positively at first are now charged negatively, and vice versa, and that some of the energy has been lost in heating the resistance. Thus we have the energy oscillating "back and forth between the coil and condenser and being wasted during the transfer." And, assuming a decrement of 0.3, this gives a "power

factor of $\frac{.3}{\pi} = .0955$: the phase difference" of the current and potential "is therefore 84.5°."

We are told, however, that at resonance "the capacity reactance and inductance reactance are equal and opposite" and that the current "is limited only by the resistance." This is true and can be best explained by reference to Fig. 3. Here we have a simple oscillatory circuit, as in Fig. 1, with the switch closed, but with the inductance loosely coupled to a source of alternating current of the same frequency as that to which circuit (A) is tuned or is resonant. In this case the current in circuit (A) will be in phase with the potential or voltage in circuit (B). Insofar

as circuit (B) is concerned, circuit (A) has no reactance, and the power factor of circuit (B) is not affected by it. Insofar as the relation between the potential in (B) and the current in (A) is concerned, the power factor is unity. But the potential in (A), provided the resistance is negligible, is 90° out of phase with the current in (A), and the power factor is near zero. Remembering the telegram from the Bureau of Standards—"the current is in phase with the IMPRESSED potential"; in case of Fig. 1, the impressed potential has ceased to exist when oscillations occur, and in the case of an arc transmitter, the impressed potential is a direct current, so cannot have a phase relation. However, the principle is still true, for, in a free oscillating circuit, the current is in phase with the **impressed potential**, or would be if there was an impressed potential. However, when we consider the current in Fig. 1 in its relation to the potential in that circuit, its power factor can never become unity unless the resistance is of such value as to dissipate the power during the first quarter cycle, in which case the power factor would be unity and no oscillations at all would occur. On the other hand, the voltage in circuit (A), Fig. 3, bears only a very indirect relation to that in circuit (B). The voltage in (A) is the counter-electromotive force generated by the inductance in its own circuit. This, in turn, depends on the current in (A), [the current in (A) is limited only by the resistance in (A)] and the rapidity with which the current changes in intensity. It follows logically that if we decrease the resistance in (A), we will increase not only the current but also the potential. As we can never do away entirely with the resistance in (A), it follows also that if we use a small value of inductance and a large value of capacity, we will have low voltage and heavy current, and that with a small capacity and large inductance we will have a small current and high voltage. But, regardless of the relative values of inductance and capacity, if we reduce the resistance, we increase the current and potential proportionately, and if we were able to reduce the resistance to zero, we would have both unlimited current and infinite voltage, no matter how small the initial power applied.

As understood, insofar as radio communication is concerned, power is radiated usefully from an antenna in two ways: by electrostatic lines of force, which may be considered a function of the volts or potential, and by electromagnetic lines of force, which may be considered as a function of the current. As both current and potential are increased by decreasing the resistance, it follows that a study of re-

sistance would be important.

In radio work, when we speak of resistance, we mean, usually, everything which consumes power in the circuit, and Morecroft defines effective resistance thus: "The effective resistance of a circuit is equal to the amount of power." (watts) "consumed by the circuit divided by the square of the current required to supply this power." Power is expended in an antenna in several ways, and, in practice, the measurement of power loss is usually made by inserting in the antenna circuit a resistance sufficient to cut the current flowing to half its original value.* When this is done, the resistance inserted is equal to a resistance that would dissipate the same power as the antenna does, and consequently these power losses are all classed together as the "effective resistance" of the antenna. And, as we have seen, anything that is done to reduce the effective resistance of the antenna will increase both current and potential, so it follows that decreasing the effective resistance will increase the proportion of power that is usefully radiated.

It fortunately happens that the measurement of effective resistance is one of the simplest measurements in radio work. The reader is referred to Bucher's "Experimenter Manual," "Bureau of Standards Circular No. 74," and other textbooks on the subject. In these days of C.W., almost any serious-minded experimenter has, or can get with small expense, all the apparatus necessary; and actual measurements of resistance, even if the methods used are not so precisely accurate, will upset a lot of ideas many of us have as to just what is best in antennae, as well as other pieces of radio apparatus.

In order to point out some possible practical uses of the data secured by antenna resistance measurement, we will consider some of the problems that many of us have met at one time or another. For instance, we have often been told that there is one best wave at which an antenna should be operated to secure best results. This has often been considered as having a definite relation to wave length, and has often been stated as at a point about twice the fundamental of the antenna. This is often far from correct, as this point is always the wave length at which the antenna has the lowest effective resistance. Actual measurement of the effective resistance of a number of antennae shows conclusively that no two have the same characteristics. An antenna has a different effective resistance for every wave length to which it may be tuned, and it is well to take a series of measurements over quite a broad band

of waves in order to get as much data as possible from which to draw conclusions as to what changes would be advisable. Fig. 4 approximates the curve obtained by measurement in the case of one antenna. It was desired to operate this antenna over a band of wave lengths. In attempting to tune it, it was found impossible to secure anything resembling a satisfactory condition of resonance at 425 meters, although the fundamental was 350 meters; at 600 and 700 meters the radiation and decrement were good; and at 900 meters, the decrement was again bad. Signals were excellent on 600 meters and 700 meters, but broad, faint and unsatisfactory on the other waves. Examination of the resistance curve indicated the presence of conductors in the

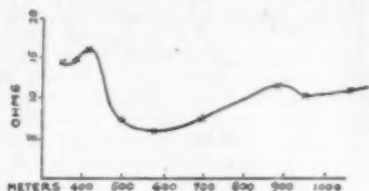


FIG. 4

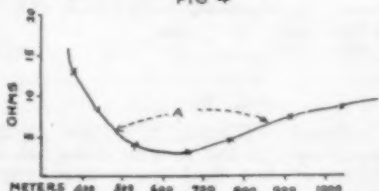


FIG. 5

neighborhood that were at resonance with the antenna at near 400 meters and 900 meters. Thorough grounding of a nearby metal roof completely removed the "hump" at 400 meters, and when the transmitter was tuned to 900 meters, and the key held down while search was made in the neighborhood with a wave meter, it was found that the system of gas piping in the building was carrying heavy current at that wave length. Bonding the gas pipes to other pipes at frequent intervals almost completely removed the "hump" also, and the result was a curve very nearly like that in Fig. 5. Upon retuning, the antenna operated very satisfactorily on all wave lengths between 425 and 900, with no one markedly better than the others, and with decrement and antenna current in direct proportion to the resistance at the various waves to which the transmitter was tuned.

Another antenna measured gave a curve as in Fig. 6. As it was desired to operate this antenna as far as transmitting was concerned on 200 meters only, it was obvious that if it was shortened slightly, this would bring the point of lowest resistance to 200 meters. When this was

*This value varies with the nature of the excitation current.—Editor.

done antenna current was increased from $4\frac{1}{2}$ to 6 amperes, and the sharpness of the wave and signal strength were both increased proportionately. Other uses of these measurements will suggest themselves to those who take the trouble to make and use them. It should be comparatively easy to reduce the resistance of an amateur antenna to something like .5 ohm, which would mean an antenna current of something like $4\frac{1}{2}$ amperes from a ten watt transmitter.

If we admit that the voltage of the antenna bears no relation to the applied voltage, but is the counter-electromotive force set up by the current flowing through the inductance of the antenna system, then it is evident that, as the greatest current will flow at the wave length at which effective resistance is lowest, the combined values of current and potential will be greatest at that wave length also. As the antenna radiates energy in the form of electrostatic waves and magnetic waves, which may be considered as functions of potential and current respectively, it follows that the greatest proportion of the total energy applied will be actually radiated at that wave length at which the antenna has the lowest resistance. As the electromotive force generated by the inductance depends not on the amount of current flowing through it, but upon the rapidity with which the current changes in intensity, it follows that, for a given current, if we increase the frequency (or decrease the wave length) we will increase the potential of the antenna, and so may increase the proportion of power radiated, provided both current and inductance remain the same. If, to reduce the wave length, we remove inductance only, we will have the same current at higher frequency flowing through less inductance, and the increase will be relatively small if any. In fact, if to reduce the wave length it is necessary to remove any great proportion of the inductance, the voltage may actually be lower at the shorter wave. On the other hand, if we lower the frequency (lengthen the wave), we usually add inductance only, and the additional inductance added to lower the frequency really increases the potential of the antenna system. Thus, the values of potential actually secured are not proportional to the changes of frequency through a given inductance (which would result in higher potential for higher frequencies) but often the reverse, as they are the result of the counter-electromotive force generated by the amount of inductance used to secure the wave length desired. When we decrease the wave length, we immediately begin to "climb up" to a point of higher resistance on our resistance curve and cannot maintain the same current as at the longer wave.

Both current and voltage fall off, and we do not radiate nearly so large a proportion of the energy we apply to the antenna. Consequently, there seems to be something wrong with the "dope" we have had for so long concerning radiation resistance. If we concede that the power actually radiated depends on both current and potential, then, knowing that these values are both greatest at lowest effective resistance, that portion of the resistance curve close to the fundamental cannot be considered as radiation resistance except inasmuch as the higher frequency at the shorter wave length increases the potential. In fact, actual results as to signal strength bear out such assumption, and attempts to operate C.W. transmitters close to the funda-

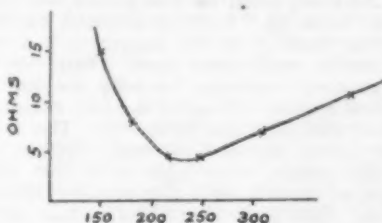


FIG. 6

mental wave length in order to take advantage of the supposed higher "radiation resistance" have proven that "it can't be did." It is often better to cut off part of the length of the antenna in order to reduce the capacity, so as to be able to operate the antenna at its point of lowest resistance. This does not necessitate removal of inductance and consequent lowering of potential, and, in several cases, has resulted in marked increase in signal strength, even when the height of the antenna was lowered materially.

As the effectiveness of an antenna in actually transmitting signals to distant points depends not only on the power actually radiated, but on its effective height also, the amateur is confronted by a "pretty problem" indeed. In consequence, so as not to decrease that precious "effective height," he puts in enormous ground systems, uses very large conductors, puts up many wires, and goes to all sorts of extremes in order to better conditions. And much of this effort is wasted, because we have never had any definite rule to judge as to the effectiveness of these various measures. Actual measurement of resistance gives us that "rule." For experiment recently I put up a two-wire antenna of the same length as a six-wire one, and very much to my surprise found that the two wires had less resistance than the six. And the two wires actually gave greater antenna current than the six. However, when

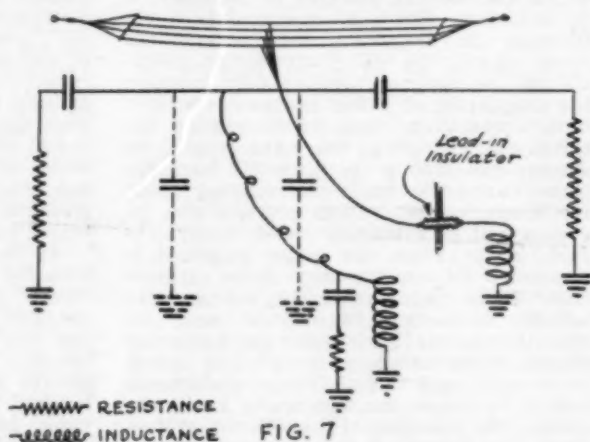
the two wires forming the lead-in were twisted together, the resistance actually increased from 6 ohms to 14 ohms, with correspondingly lower antenna current and signal strength. This was surprising, as I supposed that twisting them together would result in lower capacity only. After measuring a few antennae, I came to the conclusion that a good many of the opinions that I had formed concerning the effectiveness of various methods were entirely wrong. This especially, because the conditions disclosed by measuring the resistance were in exact accord with what the station was actually doing in the way of signal strength at distant stations. One station in particular has been a "Jonah." We have built antenna after antenna, tuned and retuned, piled on the power till something "blew up," secured antenna currents varying from 6 to 40 amperes, but with the result each time that when we had the greatest antenna current we had the weakest signal. Measurement of resistance at last disclosed the difficulty. The resistance curve showed several "humps" at critical points, was high over the entire range of waves, and the remedy was obvious. The ground system, while extensive, consisted of three long copper strips, buried deeply, and was totally inadequate for the station.

When one begins to lower the effective resistance of an antenna some surprising conditions are disclosed. Antenna current goes up; of course. Insulators begin to "let go" that have been perfectly satisfactory for a long time. The antenna begins to brush, and with C.W. especially, things get hot in the most unexpected places. Losses are disclosed that were not at all evident before.

Fig. 7 shows an antenna and the equivalent diagram of the effect of its various parts. It will be noted that the insulators have been shown as condensers shunted by resistances, including the entering insulator; and that is really what they are. Unfortunately, many of the insulators furnished for radio work are not only made of material that has high dielectric losses, but they are so constructed as to have considerable capacity in themselves. It is evident that current will flow through their capacities in the direct proportion that the sum of these capacities bears to the capacity of the antenna as a whole. One antenna that I measured showed such a surprising value of capacity that the insulators were removed and measured separately, and it was found that the capacity

of the insulators represented one-third of the entire capacity of the antenna. That means that one-third of the power that actually got into the antenna passed through the insulators, and, consequently, could do very little toward making signals at the distant station. If the resistance of the path through these insulators were high, due to various losses in circuit, then these losses would be included in the measurement of effective resistance. But, should the insulators be made of good material, free from dielectric loss, and connected in such a manner that the circuit through them had low resistance otherwise, the measurement would disclose low resistance, and yet a considerable portion of the power applied would pass through them and do no useful work. In one case it was found that the current flowing in the antenna lead was 2 amperes less outside the entering insulator than it was when measured inside. Yet, when a new entering insulator was provided and this loss corrected, the antenna resistance remained practically the same.

When we sum it all up, it is evident that most of the methods used by amateurs to improve their stations were based on sound principles, and for that reason were effective. Many of them were not nearly so important as supposed, and it is entirely probable that many things that can readily



be done to improve the effectiveness of our stations have been overlooked entirely.

Consideration of the problem from this standpoint seems to me to indicate that the antenna system is probably the least efficient part of the equipment that goes to make up a radio station, and it is certain that it can be very greatly improved indeed. In fact, an antenna has been experimentally erected, of size suitable for amateur use, which has a resistance of less than .2 ohm; this would mean, with a 1000

watt transmitter, 33% efficient, an antenna current of about 40 amperes, and that would certainly win in any Trans-Atlantic test.

As to receiving conditions, results are in all cases as advantageous. Here we have the impressed potential applied to the antenna as a whole, rather than to a portion of the inductance. Again, the current in the antenna is limited only by its resistance, and the potential is that generated by this current passing through the inductance. Therefore the amount of energy that will accumulate in a receiving antenna, all other conditions remaining the same, is in direct proportion to its effective resistance.

Suppose we have an antenna of 12 ohms resistance and that when the receiver is coupled to it, the added effective resistance

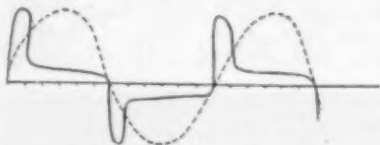


FIG 8

of the receiving set is equivalent to 2 ohms. In such a case, 6/7 of the power received is consumed in losses in the antenna itself, and only 1/7 in producing the signal. However, should the antenna resistance be reduced to 1 ohm, the effective resistance of the receiver remaining the same, only 1/3 the power received will be expended in the antenna and 2/3 will be available for producing the signal. In practice, this 2/3 is not required for signals of appreciable strength, and the effective resistance added to the resistance of the antenna by the secondary of the receiver as ordinarily coupled and used is considerably less than the estimated two ohms, but the principle is as illustrated above. And with the low resistance, the antenna presents higher impedance to frequencies other than those to which it is tuned, and so tunes more sharply and is much superior in regard to selectivity. These results and the conclusions drawn are in exact accord with results obtained at stations at which such changes have been made. Of course this explanation takes no account of the "negative resistance" characteristic of regenerative receivers under certain conditions.

Now, to "hark back" to the article in February 1921 "QST" and the subsequent discussion. Certain questions were asked, but the discussion did not go very far in answering them. I believe that when these problems are considered in the light of the explanation given it will be clear that the results obtained are in direct relation to the principles outlined.

One thing is as yet unexplained. Why does the little tube set with 5 or 10 watts cover the same range that the 1 K.W. spark does? I can so far see but one explanation that seems at all probable. Aside from the question of the relative sensitiveness of heterodyne reception the explanation perhaps lies in the form of the wave emitted by a tube transmitter. It is possible that the wave form of the high frequency current generated by the tube transmitter is such that the current rises sharply at certain points and so generates in the inductance of the antenna a considerably greater potential than would be the case if the wave was a pure sine wave. Referring to Fig. 8, if the wave was as the heavy line, the potential resulting would be approximately six times as great as that resulting from the pure sine wave, as shown by the dotted line. [But the harmonics generated by this non-sinusoidal wave form are awful!—Ed.]

Actual oscillograms taken of the plate current in vacuum tube transmitters show great wave form distortion, and conclusions drawn from them indicate clearly that the greatest efficiency results when conditions are such as to produce maximum distortion.

Consideration of the foregoing leads to the inevitable conclusion that appreciable radiation can only take place from an antenna when the phase relationship between the current and potential is such as to secure the greatest possible values of current and potential for the power applied.

It is a well known fact that radio frequency currents can be transferred from one circuit to another at non-resonance with almost equal efficiency as at resonance, but in this latter case the values of potential and current are so small (current and potential are in phase to a great extent under non-resonance conditions) that very little radiation results.

Amplifiers versus Detectors

By L. Q.

WASHINGTON THOMPSON wasn't this negro's name but that's near enuf right.

He used to brag about the way his mule could kick.

One day a neighbor asked how well the mule worked.

"Wuk? Dishyeh mule don't wuk. He kick! Dot his speshulty—yessah—he kick—he don't wuk!"

Moral—Don't think you've a good receiver because it's got lots of kick—because 9ZN comes in all over the place. Does it go somewhere? Or does it just stay nearby and kick? .

The Third and Fourth District Radio Convention

Reported by Chas. A. Service, Jr.

THIS is the story of a bang-up convention the boys of the Third and Fourth Districts staged some six weeks ago in the City of Speeches.

No, it is not a post-mortem because that convention is far from being a corpse in the minds of those who heard the call and hurried to the Hotel Raleigh from Pennsylvania, New Jersey, Delaware, Maryland "and all points south" on a zero February morning to find one of those warm southern receptions waiting at the station and hotel; and in about the space of one electron emission, mind asserted itself over matter and every ham, super-ham, near-

he's wrong, two "bottle-workers" fingering knuckle-dusters and a lead pipe all aglow to tune up on an unprotected spark man, hams hiking hither and yon like unattached electrons until attracted to some positive young oracle with more regard for a flow of soul than the pure light of reason, hams in groups, in festoons, in waving lines and tight pressed knots, hams freely oscillating and hams damped down by OW's or YL's, all actuated by a single impulse, to get all out of the Convention the Convention had to offer—and they weren't disappointed!

By the way, Hill, 4GL, of Savannah, Georgia, and Harrod, 4II, of Orlando,



ham and hamlet was spreading his doctrine or lapping up knowledge from somebody else's think-tank. Whoso wanted an audience had but to work his jaws faster than his neighbor and straightway he was surrounded by an eager, buzzing group like flies around a gum-drop; subject matter made no difference. There were hams from whose lips dripped facile cosine-thetas and components and characteristics and things, while the more earth-earthy took a worm's-eye-view of radio and covertly asked who wanted to buy a spark set cheap.

But this is an ante-room impression; a dozen steps, the rapid exchange of words and notes with the door monitor and the lucky lad or lass passed within the portals of the exhibit room, to be greeted by that sight of sights, the radio ham at ease. Imagine exhibit tables around the walls manned by designing demonstrators and sweating salesmen with one eye on business and the other on their vacuum tubes, surging crowds of craning hams, knots of open-mouthed Marconis around the leading exponent of C.W., itching to tell him where

Florida, were there from the Fourth District, sent there by popular subscription raised by the boys in those States to represent them. How's that for A.R.R.L. spirit, fellows? And those contributions were raised in about ten days, too!

When things began to look like the 1907 Wall Street panic, the first meeting was announced and by dint of much persuasion the O.M.'s and O.W.'s were induced to sit down and keep quiet while Mr. Terrell, Chief Radio Inspector of the Department of Commerce, formally opened the Convention. That opening speech started things off right; here it is verbatim. What is your reaction?

Officers, Members and Friends of the American Radio Relay League:

"I thank you for your invitation to attend the Third Annual Convention of the Third and Fourth Radio Districts.

"I have been asked to tell you that you are welcome here. I think you would prefer to be shown and this we shall endeavor to do. No one need be told he is welcome in

Washington. It is your city. You will also be welcome in Room 509, Department of Commerce, and a visit by you will be appreciated.

"I had the pleasure of attending your National Convention in Chicago last August. At that time I was requested by our Secretary, Mr. Hoover, to obtain from the members of the American Radio Relay League their views as to where the Department of Commerce can be of the best service to them. I renew that request.

"You have no doubt seen in the newspapers articles concerning the radio conference which the Secretary will call, at the request of the President, to investigate the development and use of the radio telephone. I understand the American Radio Relay League is to have a representative on the committee which will conduct this investigation. You will have an opportunity to present your views and make recommendations which may be useful to the commit-

Third District, February 10.....	1,664
Fourth District, February 10.....	294
Fifth District, January 31.....	614
Sixth District, February 8.....	1,474
Seventh District, February 2.....	644
Eighth District, January 31.....	2,250
Ninth District, February 8.....	2,664

Total14,179

"An increase of approximately 4,000 since the first of last July

"Receiving stations are not recorded and we have no reliable information as to the number. I expect the Secretary would be willing to give another cup to the amateur who can guess the exact number, if he can prove it.

"Broadcasting promises to become one of the most valuable functions of radio, if properly protected and regulated. It will no doubt be one of the most important problems to be considered by the coming radio conference and I hope some plan can



tee in reaching conclusions affecting the use of radio by the amateurs. It is fortunate for you that you have an organization composed of practically all of the foremost amateurs of this country, recognized as being law-abiding, unselfish, and progressive. This organization is Uncle Sam's best training school for radio operators and radio engineers of the future.

"There is at present, and I hope there always will be, just one amateur radio organization of the amateurs, by the amateurs, and for the amateurs. Your power and influence for good can be fully realized only through united and unselfish effort. I hope there will never develop any personal jealousies or factional differences to disrupt your splendid spirit of co-operation, so valuable to yourselves and so helpful to us.

"It may interest you to know how many licensed amateur radio stations there are in the United States, as indicated by the latest reports from each district.

First District, February 8.....2,440

Second District, January 24.....2,135

be devised which will insure its successful use. The benefits to the public through radio broadcasting are almost unlimited. The service rendered should be determined by the public if its full value is to be realized.

"You can lead a mule to water, but you can't make him drink. You can broadcast what you like but the public will not listen to it if it is not what they want to hear.

"With the rapid development of inland radio, amateur stations and broadcasting, we are confronted with the problem of investigating complaints of interference. With our present force we have been unable to give much attention to inland radio. Until recently radio has been in the hands of people who had some knowledge of its use. Now we have receiving sets in the hands of farmers, farmers wives, bankers, grocers, and everybody who wants to be fashionable. They have no knowledge of adjusting the apparatus; in fact, I have heard much of the apparatus is so simply constructed that selectivity is impossible.

"I think we are going to find it necessary

to call upon the American Radio Relay League for volunteers, dollar-a-year men, to act as deputy radio inspectors in each State, until we can get an appropriation sufficient to meet this emergency. I believe we are going to find it necessary to have a radio inspector in each state, possibly two in each state, provided with a transmitting and receiving set, to keep in touch with actual radio operating conditions, regulating the schedules and giving advice to the new users of radio. As I view it, there is a big job ahead of us and we will need your co-operation.

"I am reasonably sure there must be a change in allocation of wave lengths.

"I believe it is going to be found necessary to ask the amateurs to release the special amateur wave length of 375 meters to make room for broadcasting. What do you think of the following wave lengths for the amateurs: 175, 200, 225 and 250 meters. And what do you think of assigning them something like this: 175 for tele-

cial Amateur operators license? To be issued to amateurs who have had, say ten years experience; code speed 15 or 20 words a minute. But to be issued only to amateurs who have not had their licenses suspended or have been fined for a violation of the law. Such licenses not to be renewable if a violation is recorded against the holder.

"We would like to know if the amateurs desire us to print monthly a list of the new amateur stations licensed; something like the Radio Service Bulletin (wild applause). We may not have the money to do this but if it is wanted and needed we may be able to get the money, if we can show there is sufficient demand and need for it. The cost of publishing our lists comes out of our appropriation but this money is not returned to us when the publications are sold. It goes back into the Treasury through the Printing Office.

"Before leaving you, I want to thank you for your splendid co-operation during the



The Banquet on Feb. 18th

phones and broadcasting; 200 to the beginners, either spark or C.W., during the period of their first license; 225 to CW exclusively after two years' experience, and 250 to special amateurs for either spark or CW. To do this it will be necessary to have a change in our present law to provide for the use of 225 meters by the general and restricted amateurs, as they are now limited to 200 meters. This question may come up at the coming radio conference and you should have your recommendations ready.

"You have demonstrated you can work across the Atlantic on 200 meters. Unless you contemplate a test with China you should be willing to release the 375 meters wave length, which will be badly needed for broadcasting.

"What do you think of our having a Spe-

cial Amateur operators license? To be issued to amateurs who have had, say ten years experience; code speed 15 or 20 words a minute. But to be issued only to amateurs who have not had their licenses suspended or have been fined for a violation of the law. Such licenses not to be renewable if a violation is recorded against the holder.

Courtesy begets courtesy, co-operation breeds co-operation, and this signal recognition of the amateurs and the American Radio Relay League by the Department demonstrates what high ideals a steadfast campaign against radio lawlessness and a ready willingness to assist the Department at all times, will do toward cementing the already firm entente cordial.

A short breathing spell and time to tuck away a Raleigh lunch and the afternoon technical meeting got off to a fine start with Dr. Miller, of the Naval Radio Laboratory leading. "Antenna Design and Ra-

dio Measurements" was the subject and was followed by a whole raft of good papers and speakers, dealing with antennae and ground, wavemeters, CW design, theory and operation, audio and radio frequency amplification and about everything else worth while. These papers will come out in QST soon.

Came evening and those with sufficient strength and newcomers were turned loose again in the exhibit rooms and told to go to it. Those with the hoof and mouth disease, who had been hoofing it around all day, withdrew to their rooms to talk it over all night; many spirited arguments took place behind locked doors. An absorbed group gathered about the code table where speed birds scribbled fast and furiously and someone won a pair of Baldwins.

The second and last day of the Convention went off with a rush, starting with a fleet of plate glass rubberneck buggies that took the whole crowd to the Anacostia Naval Air station to see NOF and the multiple tuned antenna and then back across the Potomac to that gray haired father of all high powered stations, NAA, just in time to "hear time" at noon. Some noise! That picture of the gang was taken with one of those rotary camera affairs that pivot on a stand and "shoot" only one section at once; they say Bradley Martin of the Phila. Amateur Radio Association tried to fool 'em and get in the picture twice after the camera had started by running from one end to the other before the camera got there but the camera man tripped him on the run and held him down til it was over.

The afternoon saw everybody lined up for the rectifier battle in which Mr. Kruse backed the chemical rectifier, Mr. Baker the kenotron, and Mr. Tyzzer the Amrad "S" tube. When every ham had satisfied his scientific appetite and stretched preparatory to shunting his neck with a hard boiled collar for the banquet, "The Young Squirt" blew in, made himself quite at home—which was what he paid the money for—and proceeded to write "The Old Man" his impressions of the Convention and especially the banquet. Here's what he had to say:

"I am here to tell the world that I was at the Third and Fourth District Convention! That is, I arrived just before the banquet. Were you there, Old Beeswax? If not, why not? I'll bet you couldn't have found anything rotten at that Convention with a fine toothed comb.

"When I arrived at the Hotel Raleigh I found about 'steen hundred Hams and Ohmlettes on the job; they were grouped together in little knots talking about everything from leaky dielectrics to leaky roofs after the crowd has finished erecting a fifty

foot stick thereon. A little fellow who looked about as old as the bird who crawls from the Pears Soap bathtub took me in tow and gave me a dissertation on grid bias. He was some little fellow. more power to him!

"I also met the Y. L. and she sure is one of the boys; got to admit I couldn't make the eyes behave. I'm here to tell you, you ancient, tottering old knocker, the Y.L. is O.K. She talks like a regular fellow and she is sinusoidal all the way. Hold me back, crowd, my hand is trembling.

"Then the exhibits; was there much on exhibit that was rotten? I guess not! Every product displayed was A-1, even to the young feller that White and Boyer of Washington had on exhibition. He was courteous and thorough in his demonstration, but it ain't right, gang, for any he-animal to be so good looking.

"Hewitt and Meyers and their gang dragged me out to chow and we talked over Godley and things un-Godley and Prohibition. When we had finished we were in fine spirits and Hewitt was shooting traffic across the pond using a cat's back on a winter's night as a master oscillator. Gents, the spirits are willing to show how weak the flesh is.

"After cooling up, I was introduced to the Back Bone (but not the Jaw Bone, that's Warner) of our A.R.R.L. I met Mr. Maxim! I guess he suspected that I had stolen a "P" tube because his big round eyes looked me through and through, but b'lieve me, he's a fine fellow, gang, and I wish that all of you could shake him by the hand as I did in the Hotel Raleigh. Seriously, though, he seems anxious to meet us poor fish. Speaking of which, I want say right here that I admired Mr. Maxim's soup and fish suit. It did not look rotten, Beeswax, it looked magna-glorious.

"Now comes the honorable banquet. Oh boy! That banquet! Was it rotten—NIX—many times NIX. The only rotten thing was the gentleman whose voice wended its way to the loftiest heights, an African voice with a two hundred meter wavelength, a 10-amp. radiation and an illegal decrement, which proclaimed to the adolescent radiators that its owner was a Sheik. It would take all the august gallantry of the gentleman for whom the hotel was named to admit that he was a Sheik. He was a CRIME.

"Say, you ancient Tree-Toad! I'm here to chortle that Kruse and Service accompanied by Haig and Haig and that Third and Fourth District Committee know how to get up a banquet. For once in our young lives we all had enough to eat. I saw one ham stow away two men's feed, put six or eight slices of the lignum vitae in his pocket, declare that that was what he called

a man's feed, rub his hands together and saunter off. His name is Meyers.

"The fish was clean, even though it was called Potomac River Bass. Chicken soup was served in fore and aft cups. Some spooned it, some mouthed it, others used it as finger bowls. The soup was all there but Bidwell said he guessed the chicken waded through it with gum boots on.

"But I've got to cut the banquet proper short, as I want to get to the other part. Some show! The ham from Baltimore is a good actor, he knows his stuff but I want all you fellows to glimpse his partner as far as it is in my power to portray her. I stood by quite stoically during the first part of the performance but when the honorable ham fell asleep and the hamerino appeared to him in a dream and a smile and a dress made of molecules and electrons, my none too constant decrement got away from me and my pulse broke all speed records. Gosh, gang, it was good!

"By this time, Kruse was batting hell out of the air with a Magnavox. Kruse was Chairman and Will H. Hays never acquitted himself better than our Kruse. Chief Inspector Terrell put over a short speech, followed by that ever popular Inspector Cadmus. Hiram Percy Maxim was then introduced and spoke words of wisdom, as is usual with him, followed by Warner and Schnell outlining the future policies of our "QST" and its Operating Department. I must mention Tom Appleby's description of 3ZO which was illustrated by a stereopticon. I am sure that it was appreciated by all, but after Tom had described the home life of a whole family of 250-watt tubes, who shall say that many a winter overcoat was not hocked the next day in Washington?

"The end came at last as ends usually do and I was whisked away and introduced to "Chain Lightning Hill," who acknowledged me in the dignified words, "How are you, Scup?" Then he dragged me off to see 3ZY with his tribe of rebels, and after riding ten days on the Washington 'Lectrics, we arrived half an hour later, to be greeted by a hearty "Welcome, fellows!" Just imagine it, at twelve thirty A.M. he made us welcome. Is that rotten, Old Wouff-Hong? Dunnam even broke out a flock of sandwiches for us! That's what it means, crowd, to belong to this A.R.R.L. of ours. Fellers like Dunnam abound in the radio fraternity; may their shadows never grow less!

"Gosh, the wife is yelling for me to go to the store. The raisins have given out again and no one with any pep can keep house nowadays without raisins. So long, gang. Cul, but anyone who wasn't at that Convention missed something."

"The Young Squirt" got about everything in that went on at the banquet, ex-

cept the results of the election of next year's officers. Baltimore received the highest vote for the next Convention city, with Bateman, 3APT, of that city President of the Third District Council and Convention; Harry Lyon, 3RP, Vice-President; and H. A. Snow, 3ZE, this year's Convention Manager, next year's Secretary-Treasurer. The third District looks to Baltimore and these men to put across an even better convention in 1923 and backs them to the limit—but they'll have to go some!

Trump Passes On

WITH much sorrow we have to chronicle the death of Robert Kitts Trump (9BT), which occurred on February 14th at the home of his grandparents at Ottawa, Kansas. His biography appeared in "Who's Who" in but the February number of QST.

Bob was one of our old stand-bys in eastern Kansas and his absence will be keenly felt. He was only twenty-three years old, death resulting from tuberculosis following a long illness of four years which came indirectly from influenza contracted while in the Navy during the recent war. He was sent to Phoenix in an effort to improve his health but was not materially helped and returned to Kansas for his last days.

9BT was in operation up to the last and was a good live A.R.R.L. station, doing much good work in its territory. We join in an expression of sincere sympathy for Trump's relatives and many friends.

3ZO Tests With Venezuela

3ZO, the station of Mr. Horace A. Beale, Jr., at Parksburg, Pa., is participating in radio tests with Venezuela thru arrangements with the state Department of that country made by Dr. E. H. Valutini, 3d, 3AAE, of Philadelphia.

The tests commence on March 15th and continue until March 25th, covering the hour from 10:30 p.m. to 11:30 p.m. NAA time. The Venezuelan stations participating are stations AYA, AYB and AYC. One of these transmits promptly at 10:30 for five minutes, then alternating with 3ZO in five-minute transmission periods.

3ZO is on 350 meters, C.W., for these tests, while AYA, AYB and AYC use 1600 meters, tube C.W., output 1 k.w. Listening stations in Venezuela will continuously tune from 200 to 350 meters, so there is a good chance of other American amateurs being heard as well.

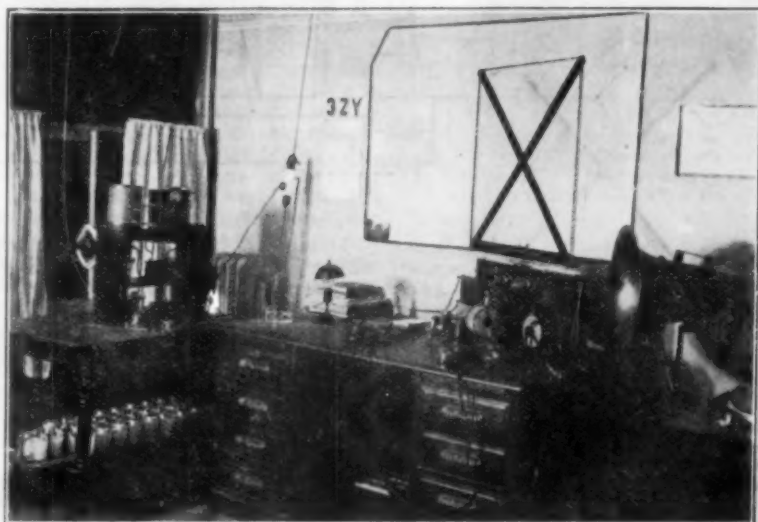
We certainly hope these tests will be successful, as it will establish amateur communication with South America for the first time and, as our Transatlantic Tests did in France, probably open the way to another international A.R.R.L. trunk-line.

The Loop Receiver At 3ZY

By L. M. Dunnam

AFTER monkeying with loop reception on several occasions with various hook-ups and nil results during the past two years the writer had long since given it up as a bad job and impracticable with less than an Armstrong super-heterodyne circuit. However, one night during the latter part of January, when static was unusually bad, the antenna and ground were disconnected from the receiver and by careful tuning

make-shift loop a permanent one was constructed, 25"x26", wound with four turns of wire and a still lower tap taken from the secondary coil. This loop was mounted on top of the receiver cabinet, revolving on a pivot, and controlled by means of a pulley and cord-belt arrangement with a knob at the lower right-hand corner of the receiver cabinet; this in order to avoid body-capacity effects when using the hands near the loop coil. Still better signal strength was had



two C.W. stations, 1ARY and 8AWP, were picked up, signals QRZ but readable. The possibilities of a loop as an enlarged portion of the secondary coil, allowing greater absorption of energy, were quickly realized. An old discarded frame about 19"x19" wound with three turns of small wire was dug out of the junk pile, propped on top of the receiver cabinet and connected in series with the secondary coil, a lower tap being taken off of the latter to compensate for the added inductance of the loop. In a few minutes about a dozen other C.W. stations were logged, 1ARY and 8AWP much stronger than without loop. With the result that the writer is now a confirmed advocate of the loop for relay work. In nearly all cases the signals were easily read, to the almost utter exclusion of static, "mush" from sparks, interference from NAA and other sources.

After the results were noted with the

with this loop. However, since the photograph was taken, another frame has been mounted in the same manner, the present one being 25"x42" and wound with three turns of No. 18 enameled, and corresponding improvement in results has been noted.

The loop is not efficient for spark. The most of the few logged were heard with the detector tube oscillating, hence on their mush notes, though several were heard on their true tones. On the other hand, KDKA, WBL and other radiophone stations were heard perfectly clear with fine audibility, in fact audible a few feet from the loud-speaker at times.

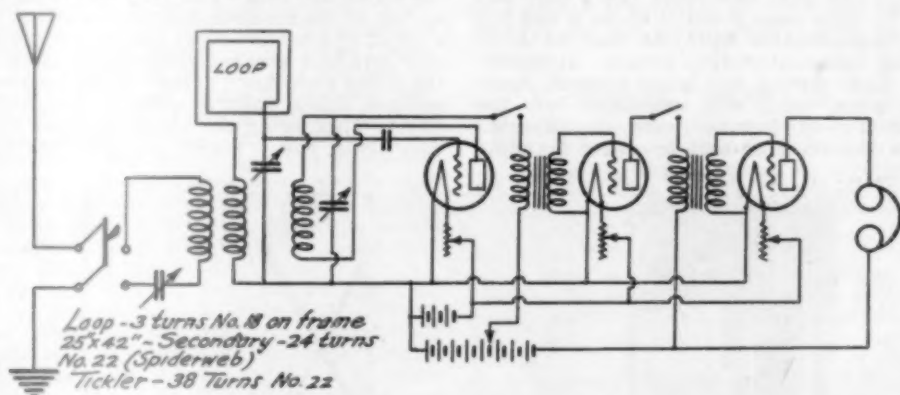
Practically all C.W. stations that can be heard with the antenna and ground are readable on the loop. While the sparks rarely are heard and interfere only in extreme cases from broadly tuned stations such as 8XE when near the wave being worked, distant low-powered C.W. sets,

down to five and ten-watts are easily worked. The furthest stations heard at 3ZY on the antenna and ground have been heard on the loop, the most distant being 6ZZ located at Douglas, Ariz., who was read with perfect ease. Break-in work has been carried on with many stations, 1's, 2's, 8's and 9's included.

It has been argued that much of the energy in the loop is obtained from a coupling

Since the loop has been in operation, about four weeks, an even 200 stations have been logged, the majority of which were readable on one step only.

If anyone trying the stunt fails to hear the usual 'racket' when he turns on his tubes, don't get disgusted and ditch it, just try a little careful tuning and hear the C.W.'s roll in, minus the nerve-racking extraneous noises.

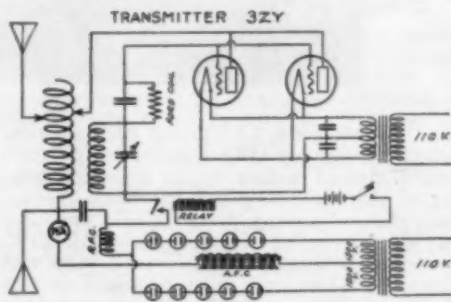


effect to the antenna lead. While it is admitted this may be true to a certain extent the directional effect of the loop and various experiments with the antenna lead, such as grounding it and shifting its position, go far towards disproving this claim. The directional properties of the loop on C.W. signals are not very pronounced but they are so as to sparks and in every case where the location of a spark transmitter is known the loop indicates its true direction, regardless of the relation of the loop to the antenna. Local DX sparks can be so reduced in strength as to permit distant C.W. stations to be read within five or ten meters of the spark's true wave.

The beauty of it all is that there is absolutely nothing remarkable about the performance at 3ZY, and the average station with a good one or two-stage audio-frequency amplifier can duplicate it. It is hoped every DX station will give it a try-out in the interests of a much larger volume of traffic which can be handled through interference and static.

While trouble may be experienced in obtaining good results from the loop when variometers are used, due to their minimum inductance, it is only a matter of about one hour's work to make up a couple of spider-web coils of proper inductance for a tickler and secondary and a loop such as is in use by the writer, which can be readily connected in any detector circuit. Solid wire, No. 18 to No. 22, is recommended for coils and loop. Litz was tried on both, with results no better, if as good.

Detailed wiring diagrams of the transmitter and receiver and a photo of the station complete are illustrated herewith. The output of the transmitter is from 3.8 to 4.2 amperes with an input of from 450 to 500 watts. The furthest points worked to date are Minneapolis and New Orleans, with signal reports from Mexico and Porto Rico. The antenna system, a one-wire



slant 80 feet high and a three-wire counterpoise extending in opposite directions from each other, is quite a handicap, which cannot be overcome on account of physical conditions.

Much credit for the performances and appearance of the station is due Mr. Herbert A. Wadsworth (3JJ), second operator at 3ZY.

In conclusion, the writer asks that anyone giving the loop suggestions a tryout kindly advise him of the results.

The Remarkable Work of 6XAD

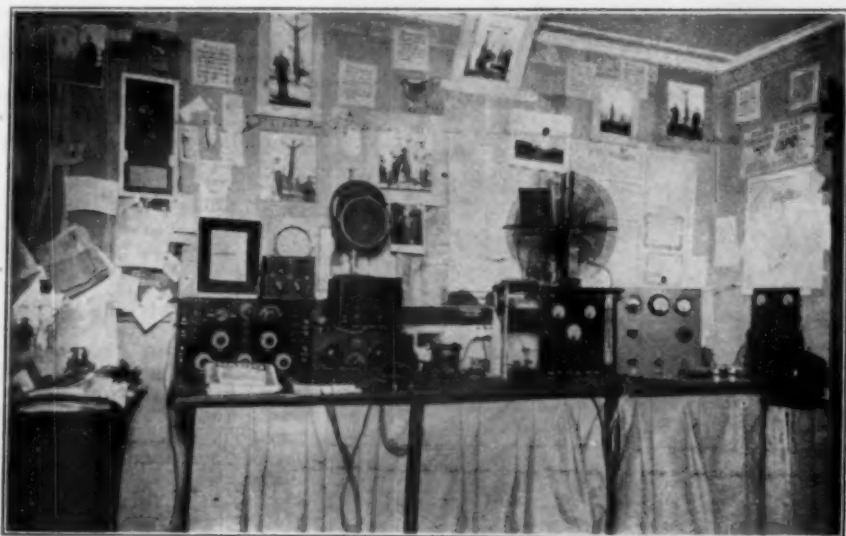
IN a recent issue of QST prominence was given the reception of signals from 6ALE at 1ES, it being stated that to the best of our knowledge it was the first time that 6-signals were heard in New England. Altho that claim has been disproved by the buzz of comment that immediately resulted in the unearthing of a couple cases of prior reception of sixes in the First, most of our correspondents overlooked the fact that we were talking about these two districts in particular, and cited many better low powered transcontinental or near-transcon records. Even so, however, it has brought a lot of interesting data to light and therefore serves a useful purpose.

Most of these records center around one station, strange to say, and are in existence largely because of the most remarkable work of station 6XAD, Mr. Lawrence Mott, of Avalon, Catalina Island, California. We believe we are safe in saying that Mr. Mott is doing the best work of any American amateur today in point of both transmission and reception, having repeatedly copied stations all up and down the Atlantic Seaboard and in turn having had his own signals reported many times from a larger number of points in the same territory. And it has not all been bare reports of signals heard—6XAD has frequently worked many of these stations,

passing messages back and forth with the ease of local communication. Of course equal credit belongs to the various indi-



Mr. Lawrence Mott, 6XAD



Mr. Mott's station—6XAD

vidual stations who have participated, but these records are possible largely because of the existence of 6XAD—he is the kingpin in the story. And we do not see at 6XAD a flock of 250-watt tubes as characterized 1BCG, nor yet Armstrong-Super tuners, but a transmitter of four Western Electric VT-2's and a conventional tuner using a detector and generally one, sometimes two, stages of audio amplification! All of which goes to show that it can be done.

Our hat is off to Mr. Mott and his confreres who are doing this splendid work in the advancement of Amateur Radio and C.W. in particular. As a typical example of 6XAD's reception, take 3FS at Philadelphia, using generally three of the tubes so conservatively known as "5-watters," but who, using but two of them, has been heard dozens of times at Avalon. Isn't that going some? And 3AQR at Hershey, Pa., who



Above, 3FS of Philadelphia. Below, 3ALN in Washington.



not only has been heard on four occasions but has been worked for a couple of hours and messages passed, 3AQR using one 50-watter. And 3ALN in Washington, also with a single 50-watt tube, who has been worked three times and messages exchanged. 8JL in Cleveland and 9AJA in Chicago raise 6XAD and chew the rag without schedule and almost whenever they want to, almost as if they were in the same city. 8AWP in Syracuse, on their small set of three 5-watters, antenna current 2.4 amps., same old story; 6XAD copied in Syracuse twenty minutes after daylight. We also have record of 6XAD working with 8BSS and 8BUM in Cazenovia, N. Y., who were audible a hundred feet from the phones, and Mr. Mott reports signals from 8BO, Detroit, one 5-watt; 8VY, Kalamazoo, two 5-watt; 3EM, Baltimore, one 50-watt, from whom a complete message was copied; 3LR, Washington, and 1ARY, Burlington, Vt., each using a single 50-watt; and 4FT at Atlanta, using two 50's. 6XAD of course is reported from many other places, including 1BLN, 2FP, 3HJ, 3BHW, 3JJ, 6ZAC in Honolulu, Canadian 3JI and 4CB, 8KW, 8KF, 8EW, 8AXI, 8ZAC, 9JQ, 8BGD, 8ZG, 8BRL, 9RC, 9ZN, 9JQ, etc.

We are fortunate in having a photograph of 3FS, which belongs to Mr. Chas. G. Benzing, of Philadelphia. The three 5-watt tubes are supplied with 700 volts from a 16-jar chemical rectifier, putting 2.6 amps in an inverted L aerial 45 ft. long of 6 wires, 60 ft. high. With two tubes, as used when reported at 6XAD and incidentally 7FQ at Tekoa, Wash., the antenna current is 2 amps. 3ALN, H. F. Hastings in Washington, D. C., uses a single 50-watt-er with about 1400 volts from a chemical rectifier, the tube space current being 150 mils and the antenna current 3.5 amps. Mr. Hastings reports that 6XAD has been heard frequently, generally swinging slowly, and will fade out a few seconds at a time and then be in steady for a half hour.

All of the above transmission from 6XAD has been on the "low-power" set of four 5-watt tubes, I.C.W. Mr. Mott also has a

100-watt set on 370 meters, straight C.W., which has been reported from Hamilton, Bermuda!

All of these results are truly wonderful considering the low powers used. They are second in distance only to the remarkable performances in the Transatlantics, but this work between Avalon and the east has been done on no pre-arranged schedules and almost nightly 6XAD has been in communication over some such distances. It should be borne in mind, to be fair, that a so-called 5-watt tube is capable of much greater outputs and that most of the men using them are probably getting 20-watts out of them, but the results are remarkable none the less. And the beauty of it is that any station with proper antenna and ground system and properly adjusted can duplicate these performances!

Chicago Council Gets Smith Cup

THE Chicago Executive Radio Council has been awarded the S. W. Smith Cup for the most outstanding achievement in Citizen Radio during the summer season of July 1—November 1 of last year!

As announced in QST last July, Mr. Seymour Wemyss Smith of "The Hartford Courant", ardent member of the A.R.R.L. and the Radio Club of Hartford, offered a silver loving cup to be awarded for distinctive achievement in the amateur world under the auspices of the League, and Mr. S. Kruse was good enough to act as Chairman of a Committee of Judges and handled the matter with his customary thoroughness. His committee consisted of one man from each radio district, as follows:

Irving Vermilya, Marion, Mass.....1ZE
A. A. Hebert, Nutley, N. J.....2MP
S. Kruse, *Chairman*, Washington, D.C. 3ABI
E. H. Merritt, Atlanta, Ga.....4XC
John M. Clayton, Little Rock, Ark....5ZL
A. E. Bessey, Sunnyvale, Cal.....6ZK
Royal Mumford, Vancouver, Wash....7ZJ
A. J. Manning, Salem, Ohio.....8ZG
R. H. G. Mathews, Chicago.....9ZN

These judges were all asked to submit nominees for the cup from the district they represented, and meanwhile an article in QST made a similar request of the general membership. Twenty-odd entrants were received and tabulated by the Chairman and submitted to the Committee for voting. Scoring was on the following basis: a vote for first place counted 5, second place 3, third place 1; a vote for "no award" counted 0 in all three places. The ballot was as follows:

Chicago Executive Radio Council,
for the conception and staging of
the first national amateur radio
convention and also for their past
work in conceiving, putting into
practice and proving the workabil-
ity of the "Chicago Plan" which
has become the national standard
in the conduct of citizen radio
communication21 points
H. W. Castner, Portland, Maine,
for his noteworthy work in the or-
ganization of the Maine region.. 7 "
C. L. Austin, Portland, Ore., for
the design of the tube set used at



The Smith trophy

his station, 7XF.....	6 points
Boyd Phelps, Minneapolis, for a technical article entitled "Radio Below 200 Meters".....	6 "
L. C. Young, Naval Air Station, Anacostia, D.C., for his persistence and operating skill which contributed to a large extent in the fine performance of station NSF, the first powerful short-wave C.W. station.....	5 "
L. A. Kern, Univ. of Michigan, for the organization of a radio press service.....	3 "
J. K. Hewitt, Brooklyn, for the first definitely established trans-continental amateur tube work, between station 2FP, installed by him, and station 6ALE at Reedley, Cal.	3 "
H. J. Tyzzer, Medford, Mass., for the design of various Amrad specialties.....	3 "
J. L. Reinartz, So. Manchester, Conn., for the origination of the Reinartz C.W. Tuner.....	3 "
E. R. Bateman, Baltimore, for organization work in the Baltimore metropolitan district.....	1 "
H. H. Lyon, Washington, for operating skill and station performance as evidenced by the concerts sent from station WJH, formerly 3NR.....	1 "

There were no votes for ten other candidates.

By an overwhelming vote, then, the Smith Trophy, carrying with it the honor of recognition of substantial contribution to the game, goes to the hard-working Chicago gang who first demonstrated their co-operative ability in the formation of the justly-famous "Chicago Plan" for the division of working hours and who put across the First A.R.R.L. National Convention in Chicago last September. Chairman Kruse, in reporting for his committee, says:

"The distribution of the members, unanimous nature of the vote, and general satisfaction expressed at the result, as-

sure me that the cup has been well awarded and that it is not the mere expression of a small group that the Chicago Executive Radio Council has done the outstanding deed in favor of citizen radio which Mr.



Mr. Seymour Wemyss Smith

Smith had in mind when presenting us with the cup. It is my very real pleasure, therefore, to report that in awarding to the Chicago Executive Radio Council the Seymour Wemyss Smith Cup for distinctive achievement in Citizen Radio we express not merely the opinion of nine men but the opinion of the American Amateur who is the American Radio Relay League."

We heartily second the motion! Three big cheers for the Chicago Council!

The Second District Convention and Show

EVERY attendance record for radio conventions and shows went to smash at the second annual affair of the Second District Executive Radio Council, held in New York on March 7th to 11th at the Hotel Pennsylvania. Over forty thousand people attended the show in the five days, with an average of four thousand on the floor all the time, and literally thousands were turned away because there wasn't room for them to get in. Over sixty exhibitors were

in charge of their respective booths, the show this year occupying the entire Butterfly Room in addition to the Roof Garden—and next year it looks like they will need Central Park to accommodate the gang.

One of the most important things that came out of this stupendous affair was the establishment of a better understanding between the new-comer listeners and the old-time amateurs. It is an undisputed fact that this actually happened. The public met the amateur and liked him. The ama-

tour was everywhere and he knew all about everything and could explain it. His jargon of technical talk completely caught the fancy of the members of the general public, and the New York papers in their accounts of the affair and their cartoons reflected not the viewpoint of the rather unhappy novice listener but the spirit of the real amateur! This to our surprise, for

formed the conclusion that it consisted of the amateurs plus their fathers and mothers and uncles and aunts and cousins and grandparents—and that means that it was still an amateur crowd.

The show was officially opened at 8 p.m. on the 7th with approximately three thousand people present. Various demonstrations were given, including that of E.



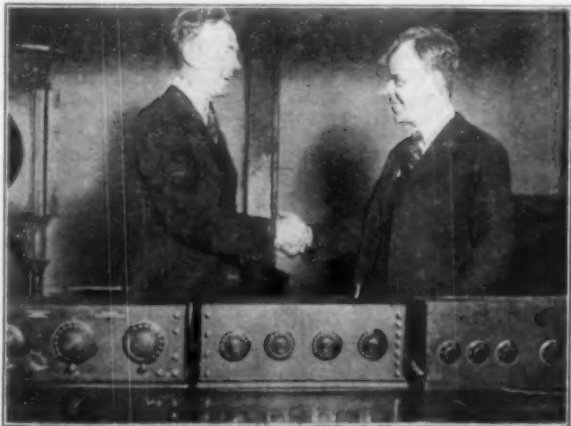
The Banquet at the Pennsylvania Hotel

we had feared the amateur would be swamped at this Show. And the banquet! Man, dear, there were only eleven hundred folks present, and who do you reckon they were? It was an amateur gang in its sympathy and spirit, almost entirely so, and looking around the big ball-room we

D. Glavin's wireless-controlled automobile, which particularly delighted the crowds. On the following days the show opened at 2 p.m. with various meetings held in the big ballroom of the hotel. On the evening of the second day Mr. W. C. White of the General Electric Company gave a very inter-

esting talk on "Vacuum Tubes and Their Operation" and Paul Godley described further his experiences in Scotland during the A.R.R.L. Transatlantic Tests in December. By courtesy of one of the large electrical corporations, movies of what happens in a vacuum tube were shown.

One of the interesting events of the Convention was the code speed contest. This was won by Mr. Jose M. Seron, a receiving operator of the Radio Corporation of American whose home is at Mamaroneck, N. Y. He attained a speed of 49.5 words a minute with only three errors. Mr. B. G. Seutter, last year's winner, copied at the same speed but with four errors. Mr. Seutter's record of last year was 48.6 words per minute with two errors. A code speed contest was also held for women,



At the Show—Paul F. Godley of Transatlantic fame and Jack Binns, hero on the first S.O.S. Photo by Keystone View Co.

Miss Ruby Yelland winning with a speed of 30.5 words per minute with perfect copy. Her closest competitor was Miss Marianna Olive Chicken with a speed of 30 words per minute, with Miss Marian Brown third, same speed.

In the Butterfly and Roof Garden there always was a big crowd viewing the exhibits and the amateurs were completely swamped by the vast number of people who came to see the latest developments in the radio art more out of curiosity than anything else. As many people attended in one day as did during the whole convention last year.

Really new features and designs of apparatus were badly lacking, due probably to the enormous demand for equipment already on the market not allowing the manufacturers a chance to make new designs and start their manufacture. QST will publish description and photographs of the few new pieces of apparatus that were displayed, in an early issue.

The foremost event of the Convention was the radio banquet to which every radio man looked forward as a happening of much importance. On the evening of the last day 1100 people gathered in the main banquet room of the hotel for what was undoubtedly the largest radio banquet ever held. After a few words from Chairman J. O. Smith, everybody fell to and stuffed themselves while entertainment was furnished by many of the artists that have given the programs from WJZ and WDY. After the eats were stowed away, Chairman Smith introduced the various members of the Convention committee and complimented them on their work. A roll call by districts was then called and representatives found present from all districts except the sixth and seventh. The first speaker of the evening, Mr. John V. L. Hogan, of the Westinghouse Electric and Manufacturing Company was called upon and he discussed the relation of the amateur to the manufacturer, mentioning that the amateur was the manufacturer's most important asset. Following Mr. Hogan General Squier, Chief Signal Officer of the Army, was introduced and given a hearty cheer. Lieut. Commander D. C. Patterson was next on the program and gave a short discussion of the history of the radio in the navy, making it impressive that the amateur should not forsake the telegraph for the telephone. Mr. David Sarnoff, Commercial Manager of the Radio Corporation of America, then followed and discussed the policy of the Radio Corporation of America and their policies toward the amateur. He mentioned that it would be proper to talk of many amateurs as commercials and many of the commercials as amateurs when accomplishing results was taken into consideration. Major Roy H. Coles, Chief Signal Officer of the Second

Corps Area of the Army which includes the second inspection district of the Department of Commerce, was the next speaker and discussed army radio in general and the great problem of getting operators in time of need. He complimented the second district amateurs on their operation and expressed his desire to have them co-operate with the Army. Next in order was a roll-call of the well known amateurs of the second district which was ac-



A popular habit at Conventions—autographed program as a souvenir

companied with much enthusiastic applause. At the conclusion of the roll-call the trophies were presented to the winners of the various code contests. The next speaker on the program was Arthur Batcheller, Chief Radio Inspector of the Second District, but who unfortunately could not be present, being in Washington at the time. He was represented by H. L. Bogardus, assistant inspector. Dr. A. N. Goldsmith then told of the work of the recent radio conference in Washington of which he was a member, representing the Institute of Radio Engineers. Next in order came the roll-call of all the clubs affiliated with the

(Concluded on page 48)

More About the Transatlantics

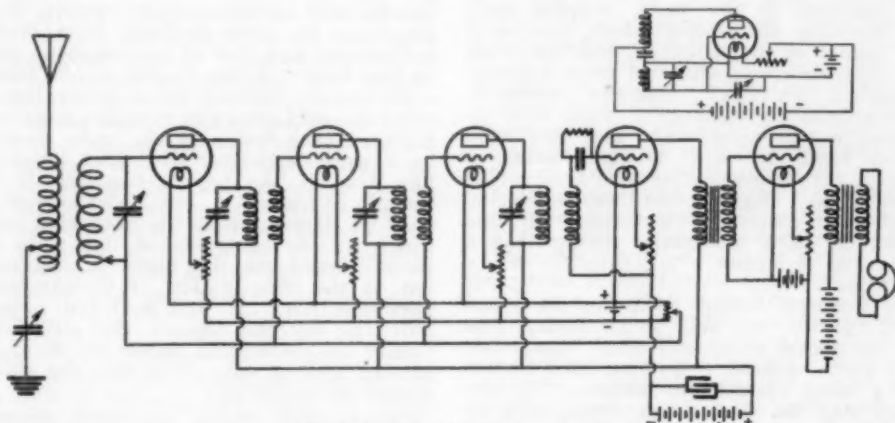
IN our last issue we mentioned some of the results of our recent Transatlantic tests by the English amateurs. Complete information was not available at the time of the above writing and it since develops that some of the statements therein were incomplete.

We are indebted to the "Wireless World" for further information and an accurate report from the British amateurs. The following stations were heard and correct code words copied: 1AFV, 1ZE, 2BML, 2FP, 2ZL. The following were heard during the free periods: 1BCG, 1UN, 1RU, 1XM, 2ZC.

steps of audio-frequency amplification. Ediswan ES-4 valves were used for the high frequency amplifiers and a Mullard "Ora" for the separate heterodyne.

Mr. Burne's antenna consisted of an inverted L type of two wires supported by a mast in the garden and one on the house, being 56 and 46 feet high respectively. The aerial is within the G.P.O. limits (a total length of wire, 140 feet) being 45 feet long and having a download of 50 feet.

The radio-frequency transformers are particularly interesting and are of the semi-tuned type. The transformer "for-



Mr. Burne's Circuit Arrangement

In England there were prizes offered for the best reception and Mr. W. R. Burne of Sale, Cheshire, was the first prize winner, Mr. H. H. Whitfield, of Birmingham, second prize; while Mr. W. E. F. Corsham of London and Mr. R. D. Spence of Aberdeenshire were joint third prize winners.

The apparatus used by the English amateurs was quite different from that in general use in this country. Some rather unusual outfits were constructed especially for the tests and we refer our readers to the February 4th and February 18th issues of the "Wireless World" wherein a complete and detailed description of the successful receivers was given.

The apparatus of Mr. W. R. Burne is of particular interest inasmuch as he heard seven different stations. We are reproducing a circuit diagram of his apparatus showing three steps of radio frequency amplification, detector and one stage of audio amplification. During the tests from three to six radio frequency valves were used with an occasional addition of one or two

mers" were turned out of solid 1 1/4-inch ebonite rod, a groove 3/8th of an inch deep containing the primary and secondary windings consisting of 30 and 35 turns of No. 38 D.S.C. copper wire, the secondary wound over the primary. These transformers were good for 180 to 325 meters with the shunted variable condensers made for the occasion.

The second prize winner, Mr. H. H. Whitfield, who heard 1AFV, 1BCG, and 2ZL, had a particularly interesting arrangement which contained some rather unusually constructed apparatus. His receiver used two steps of radio-frequency amplification, a detector and two steps of audio amplification. A three-coil tuner with single layer coils was used with long wooden handles to vary their couplings. All of his apparatus was homemade and especially for the occasion.

Mr. Corsham of London, joint third prize winner, used a detector and two steps of audio amplification, being very similar to the arrangements in general use in this country. Mr. R. D. Spence, the other third

prize winner, used three steps of transformer-coupled radio-frequency amplification, a detector and two audio amplifiers.

The apparatus of Mr. J. R. Forshaw, also a prize winner, consisted of one step of radio-frequency amplification, a crystal detector and one step of audio-frequency amplification. 1BCG was heard by Mr. Forshaw and he reports fading signals when a steam train passed by his house which he attributes to the cloud of steam and smoke emitted from the engine.

The English amateurs are certainly to be complimented on their fine work and we only hope that they will now be able to hear American signals frequently and in the very near future that we may be in direct communication with them.

Interest in France

THE French amateurs took an intense interest in the tests, copying each morning Mr. Godley's daily reports of the results of his listening, creating what Dr. Pierre Corrot, editor of their amateur magazine "La T.S.F. Moderne", calls "a most palpitating romance". Their only information was second-hand and they were rather hard put to it to make heads or tails of the cryptic radiograms they copied from MUU. Thus we find them wondering what in the world a "Beverage" antenna might be, their dictionary saying that a "beverage" means "a drink" or a "potation".

In Godley's second telegram, his statement "Heard one able yacht during free for all period sinkgap fading" completely got their animal. Quoting Dr. Corrot, "...a most remarkable sentence. It appears that Mr. Godley heard very well indeed during the open-all period an accomplished or able yacht! He therefore heard nothing from America. It is not astonishing under the prevailing atmospheric conditions."

Two days later Godley had reported 1BCG. "This time here we are! A warm rain is falling; the wind has calmed and the atmospherics have diminished in intensity. And Mr. Godley has heard one boy cast George who called him on continuous waves.... But who might be this "Boy throws George" who confirms the success of the transatlantic test? What a peculiar language Mr. Godley talks!"

And then, fellows, do you remember Godley's long message, the one with the thrill:

"One London — TC — American Radio Relay League Hartford Conn U.S.A. — Heard one ram unit two fox pup two boy mike love stop Code words of these three verified Coursey stop Also heard cables from following spark one able ram yacht one boy dog tare two boy king two dog nan three boy pup also following contin wave on able ram yacht one boy cast george one boy dog tare one boy george fox one yacht king one xray mike two fox

dog two easy have eight able cast fox eight xray vice stop Strong and reliable — Godley".

Dr. Corrot continues: "Here is a puzzle for us! A correspondent writes us: 'I'll be damned if I understand anything of this mystery where rams, dogs, foxes, yachts and even X-rays play such an important part!!! Might this not be a code?'"

"Yes, it is one! Let us consider the second part of this telegram. 'Code words of these three verified Coursey'. This shows us that the preceding sentence treats of the transmission of three American amateurs, pre-arranged words transmitted by whom have been verified by Mr. Coursey. And if we remember that the calls of the American amateurs are all issued with a number followed by two or three letters; if we notice that in the first sentence there are exactly three numbers (1, 2, 2) each one followed by two or three words; if we remember the story of Fritz, Karl, Walter & Company and that of the telephone girls, 'A like Andre, B like Bertha, C like Cecily' — we are immediately led to think that in order to avoid errors in reception they have replaced each letter of the calls received by a word beginning with that letter: A like Able, B like Boy, C like Cat, D like Dog, E like Easy.... etc. And now all at once we discover that the pretended yacht which was so accomplished, 'one able able yacht', heard on the night of December 8th, is the code station of the American amateur 1AAY... and that the remarkable 'one boy cast George' that called Mr. Godley on continuous waves on the night of Dec. 10th is none other than the station whose call is 1BCG.

"There still remain the words 'sinkgap fading' which are most incomprehensible even when we know that 'sinkgap' is an abbreviation for synchronous rotary spark gap. It just confirms in us once more the idea of an international language which exists and which is used with success, and which is the necessary complement to radio telegraphy and even more so to radio telephony. What good do the words we receive do us if we do not understand them?"

"The puzzle-telegram of Dec. 12th reveals to us in its turn that on the memorable night of the 10th and 11th the following were heard: 1RU, 2FP, and 2BML, whose code words were verified by Mr. Coursey, also the calls (cables is certainly a mistake; Mr. Godley must have written calls, perhaps not very legibly) of 1ARY, 1BDT, 2BK, 2DN, and 3BP, and finally the C.W. stations 1ARY, 1BCG, 1BDT, 1BGF, 1YK, 1XM, 2FP, 2FD, 2EH, 8ACF and 8XV, eighteen stations heard on the same night (strong and well) of which one, 1BCG, was heard the night before and two, 1ARY and 1BDT, were heard on spark and on C.W."

(Continued on page 39)

EDITORIALS

de AMERICAN RADIO RELAY LEAGUE



The New A.R.R.L. Board

AS our members all noted, the A.R.R.L. had an election of a new Board of Direction for the two-year period beginning on the third Saturday in February. Ballots were circulated in middle January and every member of the League had the opportunity of helping choose our governing body for the next term.

Twenty-two names were on the ballot, and the seventeen receiving the highest numbers of votes were to be elected. The returns were canvassed at the Board meeting held at Washington on Feb. 18th, during the Third-Fourth District Convention, and it was found that the membership had elected the following men for the new body: Harvey Mitchell Anthony, of Muncie, Ind.; H. A. Beale, Jr., 3ZO, Parkesburg, Pa.; A. E. Bessey, 6ZK, Sunnyvale, Cal.; V. F. Camp, 2RL, Brightwaters, L. I.; F. M. Corlett, 5ZC, Dallas; C. E. Darr, 8ZZ, Detroit; W. C. C. Duncan, Canadian 9AW, Toronto; A. A. Hebert, 2MP, Nutley, N. J.; F. A. Hill, 4GL, Savannah; Dr. A. E. Kennelly, of Harvard University; S. Kruse, Cambridge, Mass.; H. P. Maxim, 1AW, Hartford; F. H. Schnell, Hartford; C. A. Service, Jr., 3ZA, Bala, Pa.; C. H. Stewart, 3ZS, St. David's Pa.; K. B. Warner, Hartford; and M. B. West, 9DEA, Waukegan, Ill.

Dr. Kennelly and Messrs. Beale, Darr, Duncan, and Hill will be new faces on the Board, the remainder being re-elected from the previous board. Good men all, we feel, and we are particularly pleased to have a Canadian amateur sitting at the big table. We hope that Canadian amateurs will keep him posted on ways in which the League can help them.

After the new Board had been installed it proceeded to elect new A.R.R.L. officers for the two-year period. Hiram Percy Maxim, founder of the League and our pilot thru all the tortuous years of our childhood as an organization, was unanimously returned to the chair as our President. Similarly we have Mr. Hebert continuing as Treasurer (and a very good one he is), Schnell our Traffic Manager, and Warner as the hard-working Secretary, while Mr. Stewart, a real old-timer and our best advisor in legislative matters, becomes

our new Vice-President, succeeding Mr. Service, who declined the nomination.

These are the men that you have chosen to steer our ship of state for the next two years. They will do their best to serve you.

Amateur Self-Policing

ONE of the dreams of our A.R.R.L. now bids fair to become true very soon.

It is that we may be permitted to police ourselves by means of representatives chosen from the midst of us amateurs and deputized to act as assistant radio inspectors with enough authority to insure respect of their orders.

Of course for a long time we have had our local traffic managers, our co-operative rules and our division of operating hours—ever since there was a "Chicago Plan"—and the local radio inspectors have given us hearty co-operation and as much of their time as they could spare. But there has been a lack of authority and our executive councils and division officials have not always been able to back up their demands for good behavior when meeting up with the occasional refractory individual who lacks respect for the laws and the rights of others.

Secretary Hoover tells us that he is looking to us amateurs to take care of ourselves. He knows full well that we have been doing it pretty successfully right along, but there will be more of us and in particular a big inspection problem will come about when we start subdivision of the amateur band for the various types of our transmitters. The worst punk can see that the hope of benefit in the new system depends upon its rigid observance. Secretary Hoover says we must do that job ourselves, and so our A.R.R.L. has asked that provisions be made for Amateur Deputy Inspectors, and the Radio Commission now sitting in Washington has approved the idea, as is reported in our leading article in this issue. The deputy inspectors would be elected by all the amateurs in a community, and of course that means that the local affiliated clubs will be the logical places for getting together and selecting the men.

The adoption of the plan is not yet assured but with the Department of Commerce proposing it, we amateurs ourselves wanting it, and the Commission recom-

mending it, we can expect it soon. We will have more to say about it then. Meanwhile think it over, fellows.

A Word to the Novice

WE have a new term in radio nomenclature: *novice*, meaning one of the beginners in the fascinating game of wireless attracted by the phone broadcasts, as distinguished from the old-time *amateur*. We don't know who started the use of the word *novice*, and both classes of course are really *amateur*, but a differentiating word is a good thing to have and it will do as well as any.

This then is a word to the novice. There are a few hundred thousands of you now, and there will be millions shortly. To all of you these lines are addressed.

Won't you let us amateurs help you? We'll be glad to. We went thru the mill ourselves, you know—every one of us—and we know exactly what you are up against. Forgive us if sometimes we cannot repress a smile at some of your stunts. We do not grin in unkindness—we're only recalling the days when we used to try all the trick circuits we could hear of, when we used to ask a million questions, when we used to scratch our heads to figure out where this old telephone ringer or that old spark coil could be used to bring in better signals: the days when we used to be thrilled thru and thru at hearing a single signal!

We all agree that it is the most fascinating game that ever happened, don't we? We've fought it all out, you know, we amateurs, until today honestly we believe we are crackerjacks at short-wave reception. We've tried about everything under the sun and now we know just how to build our tuners and our amplifiers and how to adjust them to get the best operation out of them. We'll be glad to help you in exactly the same way. We have radio clubs in every town and we want you to feel welcome to come around and get acquainted. We regard you as much a regular fellow as ourselves, and we'll be darned glad to have you in with us!

We amateurs have transmitting stations too, most of us. And we are able to work perfectly amazing distances by dot-and-dash telegraphy, talking to each other often over distances of a thousand miles. In our American Radio Relay League we have a network of air lanes covering the entire country, and every night we handle hundreds of free messages for the sport of it, passing them on to the next fellow in the proper direction. Last month we had a definite record of 30,000 messages handled. This is a big business and it's valuable training, and we have a wonderful co-operative machine built up to make it possible.

We would like for you to know when you hear our dots and dashes that it isn't "the American small boy" playing around, but an organization of thousands of young men who are about a more or less serious business, engaged in mastering a complex art. With our amateur transmitters we have sent a friendly message from the Atlantic Coast to the Pacific and got the answer back to the Atlantic in a total of six and a half minutes! We conveyed messages from the governors of the individual states to President Harding over our traffic system in early March. For months we lent our services to the Bureau of Standards and helped in the collection of a world of data on the cause of the mysterious fading-out of signals. And recently we carried on tests with amateurs in England and nearly three dozen of our stations were heard over there! Really we are doing things, and in doing them we are advancing the art and keeping ourselves ready to serve our country again as operators if ever again we are needed.

We've been at this for fifteen years, and that experience is yours for the asking. Wireless isn't all success, and we can give a lift in the bad places. Radio hasn't been near perfected yet, and it's still subject to interference from a dozen sources. Leaky electric light lines make a noise like a spark set holding down the key and frequently will prevent any of us in an entire city from hearing a thing for night after night. Elevators, X-ray machines in hospitals, violet-ray machines, welding machinery—dozens of such devices—make a horrible clatter on the air. The transmitters on ships and commercial and government stations sometimes get out of adjustment and put a smother all over the tuner. We amateurs have been blamed for most of this, and to our certain knowledge in case after case where it wasn't an amateur transmitter at all. Please be fair to us, won't you?

Do you know that some of the receiving tuners being marketed today are not worth a damn, in our humble opinion? The manufacturers make them simple in the mistaken belief that you can't operate a real modern tuner. We threw them away years ago because they won't tune sharply enough to do us any good. Yes, we mean to say that they are a relic of by-gone days, and yet they are being made today by the hundreds of thousands for listening to concerts. Do you realize that there are 15,000 of us amateurs transmitting, with most of us crowded together near 200 meters? It's about as if there were 15,000 telephone broadcasting stations working at the same time at that place on your tuner where you get the music. Say, wouldn't you have a sweet time trying to hear the one you wanted? We had to grow away from these kind of instruments in order to pick out

our man from the thousands of others, and we use loosely-coupled tuners that have selectivity in order to do this. They are not hard to learn to operate, in spite of rumors to the contrary, and the results are surely worth the trouble even if they were. Of course you hear local amateurs on such tuners as you use—we'd hear our whole gang if we tried them for our amateur reception, and we'd get nowhere. But we know from our experience that if you'll get a selective tuner you will very rarely hear an amateur or a ship, unless you tune for them, and you'll get the broadcasts even better too.

And some day we fear this listening business will begin to pall. You'll want to transmit. There's room for you, Old Man, and when you come to the place where you want to climb in with the rest of us in the dot-and-dash transmitting business you'll be a regular amateur and will find our gang waiting for you.

To make a long story short, here's the helping hand of the American Radio Relay League, our national amateur organization!

Funds For Inspection Service

IT is now practically assured that the Inspection Service of the Department of Commerce will have adequate funds for carrying on its activities. The shameful way in which this branch of the government has been restricted financially in the past thru petty politics is well known to all of us amateurs. But for the fiscal year 1923 \$80,000 was asked for enforcing the radio communication laws and, in addition, on March 3d Director Dawes, of the Bureau of the Budget, recommended another \$50,000, pointing out that in the past two months there has been a tremendous development in the radio field, particularly in broadcasting, with some 600,000 listening-in stations now to be served and safeguarded. As Secretary Hoover states, "The interference caused by these broadcasting stations with each other and with the regular use of radio communication both in connection with safety to life at sea and for commercial purposes has been followed by demands from all sections of the country that immediate steps be taken to remedy a condition which is rendering this popular and important use of wireless impossible. Our present force is entirely insufficient to cope with this emergency."

When General Dawes, the man who has slashed the dickens out of almost every request for appropriations, recommends still more money for the enforcement of the radio laws, it is safe to say it will be forthcoming. President Harding approved the request and sent it to Congress the same day, and it is understood that there is no question but that our Inspection Service will now come into its own. The additional

\$50,000, it is contemplated, will provide an additional assistant radio inspector and another radio clerk in each of the district offices. Hurray!

We of the A.R.R.L. can take a little of the credit for this increased appropriation. Our League has been working in this direction for many months, and we can feel that we helped to bring about the improvement.

MORE ABOUT THE TRANSATLANTICS

(Continued from page 36)

Good for the Frenchmen! They figured it out exactly right, and give them credit, fellows. They will be good chaps to work with when international amateur radio becomes a commonplace. And, by the way, it gives us great pleasure to record that, possibly largely as a result of our own A.R.R.L. Transatlantic Tests, the bars have been let down in France and amateurs there are being licensed to use 200 meters and 100 watts of C.W. Soon we hope that they, like the British, will be ready to test to us and give us the privilege of repaying them for their kindness in listening for our signals.

Once having discovered the "system", "La T.S.F. Moderne" had no more trouble and proceeded in its article to interpret the succeeding Godley messages with difficulty. When Mr. Coursey let it be known that American stations were heard as well by the British amateurs, they said: "Bravo, British Amateurs! You have shown that without special installations Old Europe in spite of its hindrances can show itself to the haughtiness of Young America."

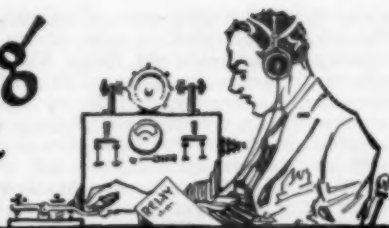
Dr. Corrot considers that the tests were a very valuable contribution to the art from a viewpoint as yet little known. "The short wave lengths, it was said, would not carry! Well, you see, they do carry. There now remains an indisputable fact whose explanation is yet to be found. Our sincere scientists do not hide their astonishment. These results, they say, are truly surprising; to cover more than 6000 kilometers with wave lengths of the order of 300 meters and with a power of about a kilowatt! It seems to them most difficult to find an explanation even somewhat satisfactory in the light of the knowledge which we possess on the propagation of waves. Perhaps, they say, we should think about the reflection of the waves from the higher strata of the atmosphere. In any case it would be premature to take up a position before more complete experiments and study may be made. Other formulae in hand show that this had to come and that it could not have been otherwise. Wave lengths of 200 meters would be, all in all, more preferable than those of 800 to 1000 meters.

"Meanwhile let us not exaggerate for it is a far cry from these experiments to a

(Continued on page 54)

The Operating Department

F. H. SCHNELL, Traffic Manager
1045 Main St., Hartford, Conn.



HOW many of you fellows in the Operating Department realize that 245 men represent the small number of good, live, snappy leaders who keep our ball of relay traffic rolling? How many of you take a bona-fide interest in reporting activities of A.R.R.L. members in your section? Why should the number of live wires be limited? It should not be limited, therefore we are going to make room for about 500 more men. Now we are not interested in dead timber! We want and insist upon having the very best material we can find. We shall accept

office with the prefix of assistant except that of the Assistant Division Manager.

The report of activities of the Operating Department will be confined to relay routes and traffic handled. Primarily, the purpose of the A.R.R.L. is the relaying of friendly messages without charge. And they must be DELIVERED. Each division will be allotted a certain amount of space in QST every month for its report and that space will be determined by the actual number of amateurs in each division and the amount of traffic handled. Such reports will be compiled by the Division Manager

Message Traffic Report By Divisions

FEBRUARY

DIVISION	C.W.			SPARK			TOTAL		
	Stns.	Mags.	MPS	Stns.	Mags.	MPS	Stns.	Mags.	MPS
Atlantic	49	2529	52	25	1643	66	74	4172	63
Dakota	8	269	34	26	2443	94	34	2712	80
Delta	6	297	50	10	1253	125	16	1550	97
East Gulf	9	616	68	11	542	49	20	1158	58
Midwest	8	362	43	12	940	78	20	1302	65
New England	2	92	46	10	956	96	12	1048	87
Norwestern	2	41	22	18	1006	56	20	1047	52
Ontario	1	24	24	3	99	33	4	123	31
Pacific	6	332	55	11	1572	143	17	1904	112
West Gulf	7	94	13	36	3080	86	43	3174	74
Roanoke	12	349	29	11	222	20	23	571	25
Total	110	5005	45	173	13756	80	283	18761	67
Total Messages, Spark, 13756, 74%									
Total Messages, C.W., 5005, 26%									

applications from everyone and the best men will be selected for the various departments. The reason for this is the fact that the entire Operating Department is being overhauled. When we get through overhauling it we will have the organization so perfected that it will function under all conditions not barring even static.

The present scheme will provide for 18 Division Managers; 48 to 60 Assistant Division Managers (one for each state); 300 to 500 District Superintendents depending, upon location; (the office of Assistant District Superintendents will be discontinued) 100 to 300 City Managers; and all other titles will be discontinued being absorbed by men appointed to some one of the above offices. There will be no

or his appointee and must contain nothing but interesting facts concerning routes and traffic handled. Special mention of good work will be made when necessary to bring out such work. No individual report of messages handled will be made in the division reports, but the complete summary for each division will be shown each month with the station handling the greatest amount of messages honored as in the past. What we want is team-work or co-operation, not individual glory hunting. We want every man to work as part of his divisional machinery in order to make the division stand out prominently in relay affairs of the League.

The Dakota Division walks off with first honors this month and it looks like 600

messages or more are necessary to cop the prize.

YANKTON COLLEGE, 9YAK

Yankton, S. D.
604 Messages
Dakota Division

MID-WEST DIVISION

L. A. Benson, Mgr.

DISTRICT OF IOWA, P. A. Stover, Asst. Div. Mgr.: The following appointments are made for the State of Iowa to take effect immediately:

Asst. Division Manager: P. A. Stover, 9YA, 213 E. Market St., Iowa City, Iowa. District Supt.: D. R. Watts, 9ARZ, Clear Lake, Iowa. Supt. of Routes: K. R. Bloomer, 9KQ, 430 Harrison St., Burlington, Iowa. City Mgr. Des Moines: A. J. Tingley, 9DEH, 829 E. 28th St., City Mgr. Davenport: R. W. Sears, 1012 High St., 9MS. City Mgr. Clinton: D. I. Bailey, 525 Kenlworth Court, 9CS.

The Asst. Div. Mgr. reserves the right to cancel any of the above appointments if at any time the duties of the officer are not properly carried out. City managers are needed for the following cities: Cedar Rapids, Council Bluffs, and Muscatine. Make applications to Asst. Div. Mgr. All station operators in the state are requested to mail a card to the Asst. Div. Mgr. before the fifteenth of each month stating the number of msgs handled and other information of value. All stations that report will be given due recognition in the district report.

The following routes are working satisfactorily: #1, 9ZA, 9BAP, 9DOF, 9ARZ, 9YAE, 9ZU. #2, 9CS, 9ACN, 9YA, 9DRA, 9AMU, 9JN or 9YI, 9OO or 9AUX, 9DBS. #3, 9AWX or 9UG or 9MS, 9ACN, 9YA, 9DRA, 9DEH or 9IY or 9OA, 9DJX, 9AEQ, 9HT. #4, 9KQ, 9PL, 9ABY, 9YO, 9AEQ, 9HT. #5, 9ARZ, 9DOF, 9YI or 9JN, 9IY or 9DEH or 9OA, 9YO. #6, 9ZA, 9DVO, 9YA, 9ACN, 9OZ, 9SL. If you want on these routes write us stating your qualifications.

9ACN is proving a valuable station on routes #3 and #2. 9FK and 9CS are high men in their section. 9AEQ gives us the following: 9DMB is on again and is proving an ideal relay station. 9XAJ at Bedford is working on 425 now and will QSR at any time. 9AEQ is changing to CW and with two fifty watters. 9MS and 9AWX roar in and are on almost any time after eleven; we have no msg report from them. 9ZU is coming into his own again and is working both spark and CW. 9YAE is helping to keep that district clear also and is doing some remarkable DX work. They maintain a constant watch, this being made

possible by having five good operators to draw from. Among the CW boys that are keeping the air hot are 9DOF, 9BAP, 9AMU and 9JN. Most of these installations are ten watt and on less than 200 meters. 9DEH, 9IY and 9OA are putting Des Moines on the map and between them they keep the city open every night.

DISTRICT OF KANSAS, F. M. Ende, A.D.M. Fort Riley, Kansas: The new A.D.M. assumed the duties of that office just twelve days prior to the date of this report with the consequence that the data at hand is incomplete.

Hutchinson is a hot spot for relay west and exceptionally business-like work has been done by 9DSD, 9DUG, 9ALU, and 9ALV.

9ALU is always QRV between 2 and 4 A.M. being unable to carry on much traffic before this hour because of blinking all the lights with his spark set. (Get on the C.W. band-wagon O.M.) 9AUG did such good work in December that his performance was commented on in the report for Missouri and he continues to be a very consistent station. He is an invaluable link in the low power "dalite" C.W. route extending across the northern part of the state:—9ASD, 9DVB, and 9DTA to 9AOG to 9BOW and 9ZE. *Wanted, a C.W. station in Western Kansas to hook up to 9BOW.*

While Kansas is an exceptional locality for transmission and reception, the QRN season is more violent than in any other state in which the writer has used a receiver. Anticipating this, the Route Manager has adopted the policy of moving traffic by short jumps (C.W. preferred) to collecting stations situated close to the more powerful DX stations which will operate on schedule. Traffic will move "dalite" to collecting stations a few miles from DX stations and just before schedule time will be given to them en mass. 9DZE and 9PS will keep Wichita open almost constantly while 9RV and 9BOA will do the same in Emporia with 9DTS at Ottawa acting as collecting station with three operators accepting traffic at noon and from 7 to 10:30 P.M.

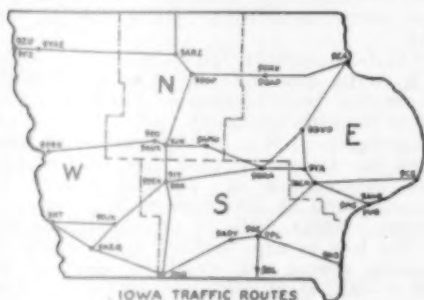
New appointments:—

Route Manager, 9PS, Ray Youngmeyer; City Mgr., Wichita, 9PS, Ray Youngmeyer; City Mgr., Emporia, 9RV, F. A. Miller; City Mgr., Lawrence, 9AOG, C. Himoe; City Mgr., Hutchinson, 9DSD, P. Wiley; City Mgr., Glasco and vicinity, 9AEY, E. Beardmore.

MISSOURI, G. S. Turner, A.D.M.:—Radio activity is due for a big boom in this state because of the new and very competent officers who have just been appointed. Plenty of things are happening down here in the Middle West and really this state is not as dead as some people imagine it to be.

The new officers who have been appointed for Missouri under the Division Managers new plan are, Mr. C. L. Klenk of St. Louis, Mo. District Supt. for Eastern Missouri, Mr. J. Abercombie of St. Joseph, Mo. District Supt. for Western Missouri. For Route Manager, Mr. O. McDaniels of 9YM fame has been chosen. Now fellows, that you know who they are, let us one and all get behind them and push. Give them your heartiest support and soon you will be surprised with the results.

Traffic has slowed up considerable in and around Kansas City the past month due to the numerous radio concerts that are



being sent out every evening from one or more of the broadcasting stations located in or near here. No work can be done at any time before eleven or twelve P.M. because of these concerts so the only fellows who handle traffic now are honest-to-goodness boiled owls. One of these birds, 9FM of Kansas City, deserves special mention because of the very efficient work he has done on a small 20-watt CW set. There are a few other stations in and around K.C. who deserve special mention but not because of any snappy relay work or long distance records. No! It is because of QRM and unlawful operating.

Stations 9EX, 9FA and 9NE, all operating small C.W. stations in St. Joseph are doing excellent work.

Going East out of K.C. and Independence we now have two new C.W. stations, one 9BNO and 9SJ. 9YM and 9DZI of Columbia are both doing fine work. Jefferson City, located in the central part of the state now has another DX station. It is owned and operated by the State Board of Agriculture. No call has been assigned it as yet but you who are acquainted with Corwins gentle voice (old 9ABD) will recognize him thru the QRM.

Appointments for St. Louis are as follows: Fred W. Schramm, 9DFQ, City Manager; Kent Ravenscroft, 9WT, 1st Ass't Dist. Supt.; Lorraine Jones, 9ACB, Ass't Dist. Supt.; Leslie Essington, 9BED, Ass't Route Manager.

DISTRICT OF NEBRASKA, John G. O'Rourke, Asst. Division Mgr.: Traffic has

been moving in the regular winter manner in this district during the past month. To date the following men have been appointed; Edwin R. Anderson, District Supt., Fred Ray Bullis, Asst. Supt. over the counties of Douglas, Sarpy, Washington, Dodge, and Saunders. Edward Mars, City Mgr., South Omaha Section of Omaha. The office of Route Mgr., and several Asst. District Superintendents have not been filled.

Not much traffic has been handled through Lincoln during the past month. 9AYS continues to do good work though on his C.W. which has caused many of the local men to give up the old spark. 9DQE reports being heard by many of the eastern fellows. 9DNC continues to be the most consistent traffic man in this section. 9WI, of York, Nebr., deserves credit for the efficient manner with which he has been relaying traffic into and from Kansas. He clears south most consistently through 9DSD. 9AIS, Sanders, of Hooper, in the north, sends in the following report; Blew up the spark set and have installed C.W. (getting to be an old story). Using two five watt tubes he has been working consistently over distances up to 500 miles. 9AIS has handled about sixty messages during the past month. He reports 9AJS is using two fifty-watt tubes with great success. 9BOQ also of Blair let his stove get to hot and burned up everything but his receiving set. He has been using ten watts C.W. At last we have several good prospects located in Fremont. Oakland stations, too, are beginning to appear on the air.

ATLANTIC DIVISION

C. H. Stewart, Mgr.

New York City has been the scene of good relay work for the month with numerous stations on the air every night. In the upper Bronx 2XK has been the link between Manhattan and the Hudson River Route. No report was received from 2CT. A daylight route into Connecticut has been established with 1VQ and 1BKG. In spite of heavy QRM, considerable traffic has gone over this route simply because the gang has been observing the rules and regulations of the Council. 2ALG is rigging up a new antenna. The West Side Zone is represented by 2AEO, 2BEA, 2BGM and 2CHK. A manager for the Washington Heights Zone will be announced next month.

New Jersey traffic is moving in all directions except into Connecticut due to lack of stations on the air. Practically all traffic was handled by the following stations: 2OM, 2ALY, 2ACO, 2AML, 2AXH, 2AAF, 2DX,—spark. The CW stations were 2AOU, 2OF, 2OM, 2BNZ, 2AJF, 2AZZ, 2AOS, 2SQ, 2CDR, 2AGB, 2ASD, and 3CG.

F. W. Applegate has been appointed City

Manager of Trenton. V. J. Braidwood has been appointed official station for Wildwood, Cape May and vicinity. Traffic stations doing good relay work are 3FP, 3BA, 3FB, 3BFU, and 3NB.

Brooklyn stations reporting last month are 2TS, 2BQU, 2AGC, 2RM, 2WB and 2PF. (Need a little help in Brooklyn so some stations will not be closed up—T.M.)

In the Hudson Valley District we find our good old reliables on the job every night with three new stations—2CE, 2ARK and 2NS. Of the old timers we find 2BM, 2DA, 2BB, 2AAC, and 2BK. (Who says they do not come back? It is reported that Runyon, ex-2ZS is all set with a powerful CW transmitter. We extend him our glad hand and wish him well and hope that he will make a report every month of his activities.—T.M.)

H. J. Brainard has been appointed city manager of Buffalo. 8QB has deserted the spark for CW and is reaching out F. B. 8BBK has done the same. 8BUM has worked 6XAD several times.

The most active stations in Pennsylvania are 8PN, 8AKW, 8ASB, 8QC, 8PT, 8BIL, 8AIO, 8BRL, 8LF, 3ZS, 8HR, 3AQR, 3ZO, and 3DM. Traffic to any one of these stations is sure fire delivery and they are on the job for all traffic.

Maryland has just five active stations in 3ZN, 3EM, 3AC, and 3HG, but these five can be relied upon for traffic in any direction.

L. M. Dunnam has been appointed district superintendent for the District of Columbia. No difficulty is experienced in traffic for Washington with such splendid co-operation of all stations. 3ALN has worked 6XAD several times. 3LR has been heard on the coast. 3JJ has broken into the DX column on several instances. The most prominent stations for last month were 3ZY, 3ALN, 3JJ, 3AFU, 3XL, 3AHU, 3KM, 3CI, 3ARN.

EAST GULF DIVISION

B. W. Benning, Mgr.

Although a great deal of traffic has been handled in this Division this month, our report is a rather limited one, due to a number of the District Superintendents attending the Convention and the consequent failure of the Assistant Division Manager to receive the information necessary for the compilation of a complete report.

Bradentown, Fla.—City Manager Clough has aroused much interest by his radio demonstrations at the Midwinter Fair. West Palm Beach, Fla.—4DZ and 4BC continue to do good work (DX) on their spark sets, but no report of messages handled sent in. St. Petersburg, Fla.—4JY and 4IW, C.W., are beginning to come through. A number of new stations are being installed

thanks to the efforts of City Manager Hall who is to be complimented on his good work in organization and boosting of interest.

Jacksonville, Fla.—There are five spark sets in Jax. All need better tuning to enable them to do DX work. We shall expect City Manager Clark to get in behind these and put them in good shape! 4ZE with the best antenna in the State, reports 121 messages handled on C.W. 4BP has his spark roaring, and will handle traffic from now on. 4EZ has a good spark set.

Orlando, Fla.—4II handled 70 messages on C.W. The Dist. Supt. wishes to heartily thank the A.R.R.L. men of Florida for making it possible for him to attend the Convention as Delegate. He discovered a thousand new ideas, which he will put to good and efficient use in his organization work throughout the State.

Atlanta, Ga.—A city boasting a bunch of genuine good fellows in the radio game—and a big bunch, too. Heretofore, it has done rather mediocre work in DX work, considering the large number of stations, but which this month did such a roaring relay business that a genuine Aurora Borealis still hangs over the city. LISTEN! FIVE HUNDRED SEVENTY FIVE messages handled! They did it like this—4FT, 280 messages, C.W.; 4CG, 86 msgs, 10 C. W. and 76 spark; 4AU, 85 msgs, spark; 4YA, 15 msgs, spark; 4CO, 30 msgs, spark; 4HS, 25 msgs, spark; 4BI, 18 msgs, spark; 4EH, 10 msgs, C.W.; 4ZF, 10 msgs, C.W.; 4HW, 10 msgs, C.W.; 4GM, 6 msgs, spark. The record made by 4FT is certainly an enviable one for this section. It is true his antenna is atop one of the "skyscrapers" but for this we will hand him a large sized laurel wreath for his accomplishment.

4FT has also made some distance records, having been heard six times on the Pacific Coast and having worked a station in Boulder, Colorado. Yet we do not lose sight of the good work done by all the others; many of them working under most adverse conditions. All stations in Atlanta are heartily co-operating in keeping down local QRM, and the general efficiency in handling DX work has been increased several hundred per cent on this account. A good deal of traffic heretofore given 4GN or 4FD for Florida points is now being handled direct with Florida stations, and this service is expected to be improved to a great extent in the early future. 4EA and 4CX are helping move quite a bit of traffic that was formerly mailed over certain dead spots. The Atlanta Radio Club is now installing a set, and the schedule is that this set will be in continuous operation every night. It is being installed by Messrs. Edwards 4CG, Pigford 4BX, and Ward 4AU. You will recollect the At-

lanta bunch told us some time ago to WATCH THEM!

Athens, Ga.—The habitat of OM 4AG. This is slyly slipped in the middle of the report just to remind folks that the OM's key is covered with cob-webs at present. However, he lubricated it sufficiently to squeeze thru twelve messages this past month—all spark.

Macon, Ga.—Ah, here we see that 4DH, of LaGrange escaped with his life and attended the Convention! No wonder we received no report from him! 4GU at Macon handled 3. 4AS at Macon handled 10. 4BK handled 90 messages with that "bottle" set he put in not long ago. 4AS is installing a C.W. set—10-watts. 4JH and 4BW while having handled no messages are doing some DX work and will probably soon get in line. Mr. C. H. Humphreys is putting in a 15-watt C.W. set.

Midville, Ga.—4GU and 4FD have long handled a big bunch of spark traffic to and from Florida points. 4FD has been tinkering with C.W. lately, and while he was thus occupied 4GN managed to jam thru 100 messages with his spark while 4FD connected to the extent of an even dozen. He will come, however!

Savannah, Ga.—4GL attended the Convention, and returning to Savannah threw so much at our erstwhile industrious Dist. Supt. that he fainted dead away. Hodge is in business on Bull Street and should have been immune, but 4GL must have a nasty left. If he sends with it we know he has—that forty per. In justice to all parties concerned we cannot do better than report, verbatim, the telegram received from 4BY on the 24th inst. after the doctors brought him around.

"Hodge 124 Hill 174 Hahne aerial down. Intermittently in communication west. Otherwise no report." Which means that 4BY handled 124 messages C.W. 4GL handled 174 messages C.W.

DELTA DIVISION

Hubert E. deBen, Acting Mgr.

All the Districts have shown exceedingly fine form and we are especially glad to note the increased activity in the Tennessee District. Supt. Hutcheson and his C.M.s deserve much credit for the good work they have been doing both in organization and traffic work.

We are pleased to announce that the Pullen Brothers, 5ZAB, Houma, Louisiana have been appointed Traffic Chiefs of the division. In the future all traffic reports should be forwarded direct to them and should be in their hands not later than the 20th of the month. The district reports follow:

ARKANSAS:—Mr. Kinsolving reports a great deal of activity prevailing through-

out his district with many new stations in operation. Hot Springs:—The amateurs there have at last put Hot Springs on the radio map in red letters. There are quite an enthusiastic number of stations with 5JB standing out as doing the "big work." 5JB has a 50-watt C.W. transmitter which raises some rumpus in the air. Arkadelphia: 5MA is doing good work with his 100-watt phone set. Conway: 5UE is treating the ether rough these days. For a new man he is exceptionally good. Morrilton: 5UC breaks out now and then and sometimes handles a clump. Why not come on more regular, UC? Little Rock: Same lineup as usual, viz: 5ZL, 5JD, 5SM, 5RO, and a couple of new ones, 5CR and 5JF. The absence from the air of 5ZL and 5JD worked havoc on our traffic total.

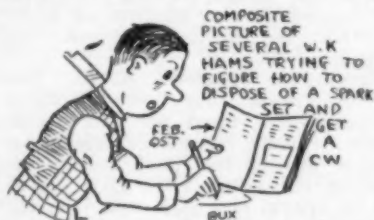
LOUISIANA—Houma: 5ZAB, Pullen Brothers, have proven beyond a doubt that their station is one of the most efficient and consistent in the country. An excellent example of what a good station in the hands of a couple of good ops can do. How that C.W. does carry, though! Although never having transmitted on C.W. 5ZAB has been reported over a dozen times and as result, they have threatened to make themselves heard on same. Plaquemine: 5KC, Vincent Rosso, is still knocking the ether for a goal out his way. He has made many improvements in his transmitter with the result that his sigs come in twice as loud as formerly.

Shreveport: 5ZS still works in spasms. Shreveport has now a wealth of stations but none other than ZS have succeeded in reaching over the city walls as yet. New Orleans: Much activity here with DX lineup as follows: 5XQ, 5LA, 5ZAP, 5AA. Brother Lehde gave us quite a pleasant surprise the other night when he handled six with 9ZJ with hardly a break. 5LA with his C.W. transmitter is also putting 'em over the plate.

MISSISSIPPI: University: 5YE is back on the air. It took Prof. Kennon nearly all winter to get started but judging from YE's sigs his efforts will be well compensated.

TENNESSEE: February was a record month for this district. More traffic was handled than any previous month. Knoxville: 5UU has been handling traffic in fine shape. 5WS has a 50-watt transmitter in operation and will be ready to handle traffic shortly. 5XK has disposed of his rock crusher and will replace it with a 50-watt C.W. transmitter. Chattanooga: 5MB has his 20-watt C.W. transmitter going and his signals have been reported from Buffalo, N. Y. 5AAG has opened up with a ten-watt C.W. Nashville: 5AAB, 5AAM, and 5NM, all have installed C.W. 5AAB has a 1KW with which he has been doing some good DX work. 5FV has disposed of his

spark transmitter and has gone to 50-watt C.W. on which he can be heard handling traffic any night. 5ER has gone back to the ole rock crusher having been unable to handle any traffic on his C.W. transmitter since December. Memphis: We are indebted to Mr. John C. Flippin, 5LF, for the following report: 5NZ has opened up with a 20-watt C.W. transmitter and is doing good DX work. 5KU has the best C.W. station in Memphis and is doing fine work. He has no difficulty handling traffic north. Wind Rock: 5DA is away from the set most of the time, but when he IS on we all



know it. He has handled most of his traffic on spark but promises to have his 50-watt C.W. going again soon.

DAKOTA DIVISION

Boyd Phelps, Mgr.

9YAK, Yankton College, Yankton, S. D., has become a real relay station for east and west traffic between 9ZN and 7's in Montana. 9AIG at Sioux Falls, S. D., is a reliable station for traffic in all directions but a great deal of his business comes thru 9AMB and Canadian 4CB. 9EA at Duluth deserves a great deal of credit in putting his city on the map and in working the Twin Cities regularly over territory heretofore unworkable.

Especial mention is due the stations on the Emergency Traffic Route who established communication during storm conditions when all of the land lines were down. A detailed report of this route appears elsewhere in QST.

ONTARIO DIVISION

A. H. K. Russell, Mgr.

The past month has been excellent for wireless work, but the broadcasting programmes have cast rather a damper over the relaying of messages.

No reports have been received from Districts Nos. 1 and 2, 4 or 6. The Division Manager would drop dead if he ever got all the Districts to report in one month. This time only Toronto and Kingston have been heard from and Kingston reports only 15 messages handled by 3HE, mostly over short distances. Tests run between these two districts worked satisfactorily from 3GE

to 3HE but no signals were heard from 3HE.

In Toronto and vicinity quite a few stations have been in relay work, 3FO being most active with 49 messages, 3EI with 35, and 3GE with 15. All the above were on spark. 9AL on CW handled 24 messages.

District No 4 has no report this month from 3BP, who came for a while to Toronto to try his luck, but who gave up in despair and went back to Newmarket, saying that he could do more DX in a night there than in a month in the city with its thousand little qrmers. We believe him, and are glad his spark is not in Toronto to add to it.

ALASKAN DIVISION

Roy Anderson, Mgr.

In spite of the fact that we had excellent weather for radio no one in the division heard anything in the way of stations that amounted to very much. Nothing further to report.

PACIFIC DIVISION

J. V. Wise, Mgr.

John F. Gray of Del Mar, California has been appointed Assistant Division Manager. Other appointments will be announced later.

District A: The traffic route to the east has been in operation with 6ZZ and 6TV handling the bulk of traffic. 6AAH takes everything for Phoenix in addition to some eastbound traffic. 6RS will handle everything for the northern end of the state.

District B: 6ZB works C.W. on 375 and spark on 200. We have a new "OW" with us at 6BAZ who is reaching out very well.

District C: This is the C.W. district. 6EN will act in place of 6ZN until further notice. Practically all stations are QSO Denver and a direct route is being established. 6ZR, 6ZK and 6ZAF have been heard in Honolulu. Among the good working C.W. stations are 6XAQ, 6ALU, 6CU, 6KA, 6KY and 6JD. The sparks are 6ZAL, 6ZR, 6ALU, 6AMN, 6GP, 6ACY, 6ALD, 6BDZ, 6ADL, 6OD and 6OL.

District D: Mr. Winsor, 6AIF has been appointed Supt. of this district to which has been added the counties of Kern, Kings, and Tulare. San Bernadino has been transferred to "C." 6AIF clears with 5ZA and 6ZA and is the only station working at present, C.W. and spark.

Districts E, F, G, H, I: 6AS has been appointed Supt. of District "F" and 6GF of District "H." Practically every station in these districts has been able to work in all directions and no definite traffic routes have been established. 6AIX in Yreka is very close to the Oregon line and will handle northern traffic.

District J: 6ZO with his C.W. opens up another route east via 6ZA. 6QR is an old standby for traffic over the central route to the east and handles his share north and south as well.

NEW ENGLAND DIVISION

G. R. Entwistle, Mgr.

The New England Division is undergoing a reorganization at the present time, the old relay routes are being polished and new ones are being whipped into shape.

Robert L. Northrup, 1COA, has been appointed executive assistant to the division manager. R. P. Siskind, 1ES, has been appointed City Manager of Boston succeeding P. J. Furlong who cannot give sufficient time to League work to do it justice.

D. Mix, 1TS, Assistant Division Manager, Connecticut.

H. W. Castner, 1UQ, Assistant Division Manager, Maine.

P. Robinson, 1CK, Assistant Division Manager, Eastern, Mass.

A. S. McLean, 1JQ, Assistant Division Manager, Western Mass.

J. F. Sullivan, Assistant Division Manager, Rhode Island.

L. G. Pollard, 1ARY, Assistant Division Manager, Vermont.

ROANOKE DIVISION

W. T. Gravely, Mgr.

Reported by A. G. Heck, 8CHO

Because of the resignation of F. L. Bunker and K. K. Kramer who could not give enough time to carry on League work, Taylor M. Simpson of Winston, N. C. will handle the entire state until other appointments can be made.

J. F. Key has been appointed Assistant District Supt. of northern Virginia.

Outside of the report from 4EA there has been little activity to report in eastern North Carolina. Outlets to the south are very good through 4GL, 4GN, and 4BY. Some traffic has been going through 4EN, and 4CX.

3AOV is reaching out to the south and west and good work is being done by 3HL, 3ZX, 3BHX, 3BNM, 3AAL, 3BHS, and 3ZAA. 3RF, 3CA, 3BIY, and 3APA handled most of the traffic.

We miss the good old stations around Norfolk of 3EN, 3XY, 3ACT, 3ACJ, 3ADJ and 3ACK. What is the matter and when will you all be back?

In West Virginia 8SP has been the leader as a vast amount of traffic has been going through during the past month. 8AUE, 8WD, 8AXY, 8BDB, and 8CHO have come in for their share without a flinch.

Just in time comes word from Richmond that 3TJ and 3MO have had a siege of the flu but are recuperating rapidly with C.W.

and spark to help them. 3BLF on C.W. has handled some traffic, and has a daylight schedule with 3BHL of Crozet.

NORTHWESTERN DIVISION

H. F. Mason, Mgr.

Extensive re-organization has been under way in this division.

Montana Section: About four stations in Montana have done consistent work through the static and northern lights which have prevailed during the past month. These are 7ZU at Billings; 7VZ at Libby; 7XB at Bozeman, who is working on 450 and has been logged off S. Carolina on a crystal; and 7LY, the A.D.M.'s station. 7EX is doing good work.

Washington Section: H. G. Reichert, 7CE, of Tacoma, our new A.D.M. is just getting things lined up and reports as follows: Traffic has moved briskly through Tacoma during the past month, stations handling DX being 7BC, 7BG, 7WM, and 7VZ on spark, and 7QE and 7CE on C.W. Incidentally, these are the only stations handling traffic on C.W. in the division. Miss 7CB will be on the air again. 7QE has been doing very good work on I.C.W. and has developed a near DX set. 7CE is planning a larger C.W. installation. 7BC reports early morning communication with 7MP a very easy matter, and has handled the bulk of the Tacoma traffic east.

D.S. Kinsey, 7PO of Seattle reports that most of the traffic there is being handled by 7IY, 7PO, and 7BK. Work can be done with 7FI, 7CK and 7MP at times but fading is bad. What we need is shorter jumps in getting the eastern traffic over the mountains and it may be that C.W. is coming to the rescue. 7RN of Cashmere and 7AAV of Wenatchee are both QSA on C.W. and as they are both located about midway between Seattle and Spokane there will be a clear ticket east. Seattle traffic has been moving regularly south to the sixes of whom a fair number are very consistent. Canadian 9AX, 9BD, and 5AK are worked to the north even though bad QSS. Canadian 4CB, at Morse, Sask. is also QSA to Seattle. 7SC of Seattle has moved to Aberdeen but he writes that he will have both spark and C.W. going again soon and will cut through the QSS which exists between there and Seattle.

Idaho and Central Section: 7YA, 7ZM, and 7YL are keeping things moving in fine shape on 375. Eastbound traffic on 200 however is nearly at a standstill. Old reliable 7FI is out with condenser trouble.

Oregon Section: Our old friend Royal Mumford of 7ZJ fame has been appointed Asst. Div. Mgr. and is lining things up in fine shape. 7BJ, at Vancouver, Wash., has been doing consistent work during the past month. 6AGF seems to be his best bet in the south with 7GE and 7FI to the

east and 7BK in the north. 7NN and 7KJ are also worked regularly. The Signal Corps at Vancouver Barracks signing CL8 have recently installed a 375 meter spark for the purpose of handling relay traffic. They work 7BC to the north and 6ZAE, 6KY, and 6KA to the south. 7ZU and 7YA have been worked from CL8 on their 15-watt fone, and the voice from a similar set at 7YA is very QSA here. 7ZJ is now handling A.R.R.L. traffic on schedule with 6ZAC of Hawaii who gives his QSL via mail. Bulk of traffic goes to 6ZK, 6ANG, 7ZU, 7ZM, 7YS and 7BK.

In Portland, 7JW, 7GJ, 7ZT, and 7BB are handling the bulk of the traffic. Owing to the fact that the higher power relay stations usually QRX early in the evening during the music broadcasts, relay traffic is handled at later hours and has fallen off. 7GJ managed to get in touch with 9YAK one morning when the QRM let up a bit. 7ED is back on the job again, clearing traffic in his accustomed manner. 7ZB is installing C.W.

C. A. Lockwood, 7TJ, the new D.S. at Salem reports heavy traffic, the most of which came through 6EX, 6AGF, 6AS, while in the 7th district most of it was handled with 7BC, 7BK, and 7JW. Eastern traffic is being routed through 6QR during the break in the 200 meter route in the Idaho section. Mr. Lockwood is to be commended on the manner in which he carries out his policy of sticking to the key until the hook is clear. 7IN of Salem is at present out of commission. The local radio club at Salem has appointed 7TJ traffic chief with two assistants, 7HA and 7MU. 7GO is doing good on C.W. Eugene traffic is being routed through 7YJ and 7OH of Corvallis. In Eugene many of the fellows are working out in fine shape. 7IW, 7HF, and 7MF are on the air every night. 7QT has recently come on the job with a ten-watt C.W. set. 7IL, 7HN and 7MF also have five watt sets.

Mr. Thibodo, our D.S. at Seaside, Ore. is with us again. 7KS is also back on the job after remodeling and has worked 7HF, 7TO, 7IW, and 7HM, 7NZ, 7NY, and 7NF have been heard on the air and we welcome these prospective relay stations.

WEST GULF DIVISION

F. M. Corlett, Mgr.

SOUTHEAST TEXAS DISTRICT; Port Arthur territory is still out. Beaumont still dead. Kountze, Texas, writes words of encouragement thru their representative station 5ZAJ, but as yet are N.D. at Houston. At present our only relay east is 5ZAB which is located beyond our border. 5XB continues to be our star station under the able leadership of "Doc" Tolson. Mr. Tolson has just recently been appointed Asst. District Supt., and is giving us the

best that is in him. Bryan, Texas is fast coming to the front. 5MX is installing a ten-watt C.W. set at Bryan. 5QQ has opened up a much needed gap between 5XB and Dallas. 5XB announces that they will not accept traffic between the hours of 7 P.M. and 8:45 P.M. thru courtesy to the concert broadcasting stations, with which they interfere.

SOUTHCENTRAL TEXAS DISTRICT; 5XU with its corps of operators, holds the air most of the time. 5ZU says that his 100-watt C.W. set is measuring up to his most sanguine expectations. San Marcos never heard anymore altho it has three fine stations; 'smatter Stephens? Elgin with 5KP and his C.W. and sink set is on the air every nite and has had flattering reports from wonderful distances on both voice and C.W. using 15-watt set. 5XU handles most of the traffic for this district.

SOUTHWEST TEXAS DISTRICT; GP4 at Kelly Field Airdrome takes first place this month. What's the matter 5ZAK, can't you find that condenser? We often hear of shot condensers but a condenser that disappears is a new one on us. Sgt. Clark at

INDOOR SPORTS - TEACHING THE
WIFF WIRELESS



Laredo is probably the busiest station as he maintains a regular schedule with Eagle Pass and San Antonio daily clearing all traffic. 5MT is doing splendid work with a ten-watt set, working well into Kansas and Illinois. 5UF having the usual condenser and gap troubles. 5ZAE, 5CH, and 5ZAK have recently made a visit to Houston, and as this report goes to press, all three are rebuilding their stations. 5ZR is on occasionally but does not maintain a regular schedule. This district regrets the loss of San Antonio City Manager Rayburn, but because of other duties and his removal from the city, his resignation was tendered and acted upon. 5ZAK is constructing a new C.W. set of 200-watts. Many busy stations failed to make their usual reports this month, including 5TT, 5TG, 5CQ, 5ZW, 5ZAA, 5NK, and 5JI. Please note this, and in the future see to it that your District Supt. gets this information on the 15th of each month.

NORTH TEXAS SECTION: D.S. Martin of Amarillo reports radio activities in his District continue to increase and a number of receiving stations are under con-

struction. Experimenting amateurs continue to enjoy the radio phone concerts, the preaching and other radio phone experiments.

5IF is continuing to relay traffic between east and west assisting 5ZA to get the stuff across. The usual route for west traffic being to 6ZZ and 6TV. 6ZZ being the most effective and consistent owing to the QRM from ninth and fifth district stations. 6TV is QSA at 5IF but closer stations crowd him out. 6AAH and 6APP are trying to establish relay schedules with 5IF but the same QRM prevents them being readable for traffic.

Traffic north has been going via 9DUG, 9ZAC, 9ABV, 9WI, 9DEZ and 9DSD. Stations 9DSD and 9ABV have been most consistent for both transmitting and receiving of traffic in their direction.

Traffic for east, southeast and northeast has been handled through 5FO, 5HK, 5IR, 5IS, 5XU, 5NC, 5NK, 5XJ, 5BY and 5PE. 5PE, 5HK and 5XU have been most consistent. The others have been QSA and were good relays at the time they were worked.

The NORTH CENTRAL DISTRICT is still plugging along in grand style and has managed to run up a few messages. 5NS, 5FI, 5QQ, are keeping things hot up their way. Edwin Gaston of the Granbury territory has been appointed City Mgr.

D.S. Neel, Dublin, Texas is having a hard time of trying to hear from some of the stations in the northern part of his District and would appreciate a letter from any of the stations up that way.

Abilene is getting along, 5YN being the most consistent station at this time.

Alton McCallan of Stamford has been appointed City Mgr. of that City.

Brownwood is doing some fine work and is ahead of most of us in as much as they have one of the liveliest clubs in this District.

All stations in Dublin are running fine with 5IR the star station. 5XJ has been crippled a great deal as one of the best operators, Mr. House has moved away.

5AO, Hamilton has been reaching out, but the fierce winds that have visited this part of the country lately, got the best of his aerial. Mr. Jordan has been appointed City Manager of Hamilton.

Report from NORTHEAST TEXAS is slim this month. Colwell reports traffic still moving in fine shape.

E. R. Mansnerius 5NC, Dallas desiring to show Mr. D. W. Hume, F.D.D. of Government Saving Division the power of amateur radio, suggested to Mr. Hume to give him a message destined to all Postmasters in Texas, New Mexico and parts of Oklahoma. Mr. Hume consented and received the surprise of his life. Mansnerius broadcasted this message nightly from his

station, likewise giving it to every station he could raise and further kept the pot boiling by sending a copy of said message to 5NK at Houston, 5IF at Amarillo, 5ZA at Roswell, N. M., 5IS at Greenville, 5XJ at Dublin asking them to go to the limit in getting a copy to every station in Texas and New Mexico. With the untiring efforts of these real bugs and others Mr. Hume's office was flooded with letters and messages from postmasters and several good sales resulted from same. Mr. Hume wishes to thank the above parties and all members of the A.R.R.L. who did their bit in putting this over and is so enthused over it he has come back for more, giving Mansnerius another message.

SECOND DISTRICT CONVENTION

(Continued from page 34)

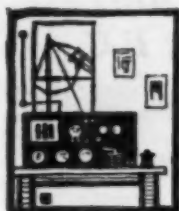
Second District Executive Radio Council and a rising call of all the A.R.R.L. members present, which included approximately two thirds of those present. F. H. Schnell, our Traffic Manager, was next on the speakers' list and gave a report of the President's-Governors' Relay which was run just prior to the Convention. Following our Traffic Manager, Paul Godley of Transatlantic fame discussed further some of his Transatlantic experiences and international amateur radio. He was presented with a large bronze tablet commemorating his work in Scotland, the gift of the amateurs of the second district.

All of the amateurs present who were successful in the Transatlantic tests were then introduced the following being on hand: 1AFV, 1BCG, 1XM, 2AJW, 2BK, 2DN, 2EL, 2FD, 2ZL and 8XV. Our President Hiram Percy Maxim was the next speaker on the list but was unable to attend, a telegram being read expressing his regret at his inability to be present, because of illness. Sickness also robbed the banquet of two other interesting talkers, Mr. E. H. Armstrong and Mr. George E. Burghard.

J. Andrew White, editor of "Wireless Age", told some amusing anecdotes on broadcasting and related some of his experiences operating at the broadcasting station WDY. The last speaker on the program was our secretary-editor, K. B. Warner, who spoke on the relations of the A.R.R.L. at the radio conference at Washington and the policies that were being followed.

At the conclusion of the banquet a reception was given to Paul Godley and everyone had a chance to shake with the man who made the A.R.R.L. Transatlantic successful.

This was the final event of the convention, and everyone declared it a very successful one and long to be remembered.



Amateur Radio Stations



7ZU, Polytechnic. Montana

7ZU is the station of Glenn E. West and has been particularly active in transcontinental relay work during the past season, being one of the connecting links with the Northwest.

The antenna is a 17-wire vertical fan supported on two masts 65 feet high and 70 feet apart. The masts are in three sections, the first being 30 feet high by six inches square, while the remaining two are

United Wireless "coffin," Dubilier .007 mfd. condenser, Benwood sink gap and a rather interesting oscillation transformer, being made of heavy multiflex braided copper ribbon, the size of which gives an effective width of eight inches in the primary coil and four inches in the secondary. The antenna current is 4.9 thermo-couple amperes on the 375 meter wave.

The receiver is entirely home-made and



of two-inch galvanized pipe. Eleven guy wires are used to stay each mast. The ground system consists of a Rounds' round ground using old hot water tanks evenly spaced in a circle 40 feet in diameter and buried to a depth of four feet. A heavy insulated wire runs from each tank to the oscillation transformer. This gives a most effective ground system and certainly one of low resistance.

The transmitter uses a one kilowatt

comprises a short wave regenerative set using variometers with a detector and three-stage amplifier, the third stage being used only when the Magnavox is in circuit.

7ZU is located at a very strategic point and serves as a kind of clearing-house for coast-bound traffic. Regular schedules are maintained with 7ZJ at Vancouver, Washington, and 9YAE at Le Mars, Iowa. These jumps are both around 900 miles and very consistent work has been done in spite of

the distance. Signals from 7ZU have been reported frequently on both coasts and the working record is approximately 2200 miles.



A new 100-watt C.W. set has just been added and it is hoped that it will maintain good consistent communication during the summer season and be of help in working through some of the fierce Ninth District QRM. The plate supply is from a 1500 volt motor-generator unit of 250 watts capacity. Further details are lacking but we will wager that the C.W. set will be heard in a goodly portion of the country.

Canadian 9BD, Vancouver, B.C.

We take pleasure in presenting this month one of the star stations of our Canadian cousins of the Northwest. 9BD is located in the Barron Hotel, Vancouver, and owned by William D. Wood. It is a special licensed station for operation on 200 meters, with spark and valves.

The spark transmitter, which is enclosed under the table, consists of a 1-kilowatt Thordarson transformer, Benwood sink gap, condenser of four Marconi jars giving a total capacity of .012 mfd., and an extra heavy O.T. A 1-kilowatt United Wireless "coffin" is so arranged that it may be used in place of the Thordarson. The spark transmitter uses a tuned counterpoise with the regular ground and an antenna current of 3.8 amps is obtained on a 480 spark note, and 4.6 amps on a 240 spark note.

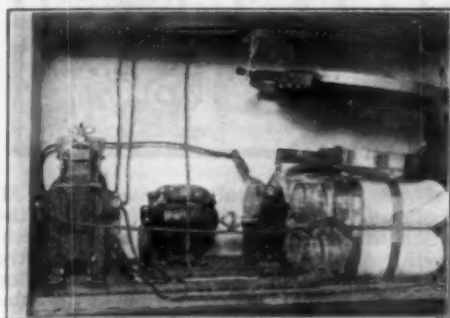
The antenna and counterpoise are located on the roof of the hotel which is 110 feet above the street level. A 41-foot pole supports the free end and a 36 foot pole the lower closed end. The aerial proper is an inverted L of seven wires with a cage lead-in, giving a total length of 100 feet. A counterpoise is used, being a duplicate of the antenna and 80 feet long. A ground is also used and the counterpoise tuned with the small O.T. under the antenna switch, which results in better antenna characteristics.

Like most of the progressive stations, 9BD has a C.W. transmitter to work with when the conditions are not suitable for spark and which has been reported up and down the Pacific coast and across the Rockies, to 4CB in Saskatchewan who has



Station Interior
At Canadian 9BD,
Vancouver, B. C.

been worked successfully. The C.W. transmitter uses four Western Electric VT-2's in a reversed feedback circuit which has



been very popular of late. The plate potential is supplied by a 500-volt motor-generator unit which may be seen in the photo-

graph near the transmitter panel. Controls are so arranged that either phone or C.W. may be used. The phone circuit uses two tubes as oscillators and two as modulators in a Heising system and has given a very good range, being heard in Portland, Oregon, a distance of approximately 350 miles. The antenna current is 1.5 amps. with an input of 50-watts on a wave length of 230 meters.

The receiver consists of a Radio Shop regenerative tuner with a home-made detector and two stage audio amplifier. A long wave loader may be inserted in place of the series condenser, which loads up the regenerator to 1800 meters with good efficiency.

9BD has taken an active part in the relay work in the Northwest and his signals have been reported on both spark and C.W. up and down the Pacific coast and the spark has been copied in Hawaii by a ship operator.

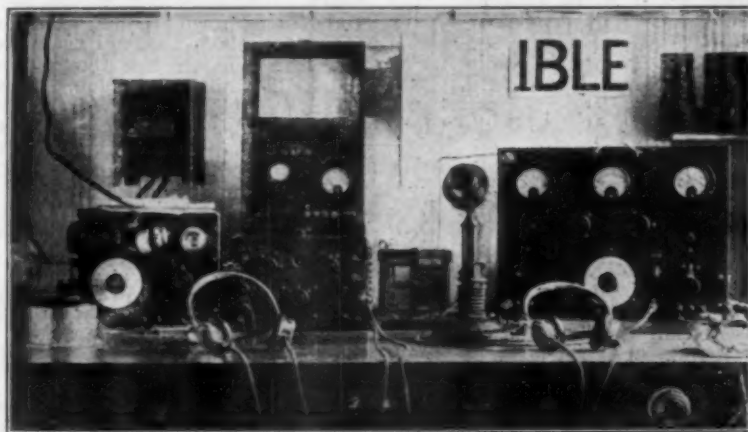
1BLE, Boston, Mass.

Here is the station of Mr. Alfred Brust at 1289 Massachusetts Ave., Arlington Heights, Boston, which has done very good work with its 20-watt C.W. transmitter and phone.

The antenna is an inverted L, two wires 90 feet long and 5 feet apart at a height of 50 feet. A counterpoise is used and con-

usual three-coil circuit, a detector and a two-step General Radio amplifier, on which amateur stations from all districts except the sixth and seventh have been copied, as well as the long wave commercial and naval arcs.

The call 1BLE has just been re-issued and Mr. McNamara, the operator, is an-



sists of six wires spaced 5 feet apart, centered directly under the antenna.

The transmitter is a twenty-watt outfit using Radiotrons and is so arranged that two tubes may be employed as oscillators and two as modulators in a Heising system. The oscillating circuit is a Colpitts. Convenient switching arrangements are provided whereby phone, straight C.W. or buzzer modulated may be used. The antenna current approximates $1\frac{1}{2}$ amperes.

The receiver uses honeycomb coils in the

xious to receive further reports on his signals.

Correction Notice.

The advertisement of the Crosley Mfg. Co., on page 131, March QST, describing the Crosley Harko Senior Radio Receiver was, through a typographical error, made to read: "The hook-up is special—of our own design and is now regenerative." This should read: —"and is NOT regenerative." —Ed.



THE A. R. R. L. has the pleasure of announcing the completion of affiliation of the following societies as of Feb. 17, 1922:

Huron Radio Club, Huron, So. Dakota.
 Amateur Radio Association of Parker, Parker, So. Dakota.
 Twin City Radio Club, Minneapolis, Minn.
 Holland Radio Association, Holland, Mich.
 Chantien Valley Radio Club, Crafton, Pittsburgh, Pa.
 Groton Radio League, Groton, N. Y.
 Asbury Park Radio Club, Asbury Park, N. J.
 The Reading Radio Club, Reading, Pa.
 The Trumbull Radio Club, Niles, Ohio.

Some of the club papers that we find great pleasure in reading and which were received last month were:

Wouff Hong, by I. R. R. L. Iowa.
 Rome Radio News, by Y.M.C.A. Radio Club, Rome, N. Y.
 Radio Digest, by Springfield Radio Ass'n.
 Delta Division News, By A.R.R.L. Delta Division.
 The Oscillator, by Y.M.C.A. Radio Club, Sioux Falls, S. D.
 Kick Backs, by Twin City Radio Club, Minneapolis, Minn.

The Chelsea Radio Association (N. Y.)

Meetings are held every Thursday night at 8 o'clock in the Hudson Guild Clubhouse, 436 W. 27th St. At the last meeting Mr. Wilson of the Western Electric Co. talked on the construction, care and practical operation of vacuum tubes. A large crowd of members listened to Mr. Wilson's very interesting talk.

Lansdowne Radio Association, (Lansdowne, Pa.)

The Lansdowne Radio Association now has about 25 members after starting out with 8 members two months ago. Plans are now being made to install a complete transmitter and receiver for relay work. Meetings are held every Tuesday evening at 8 o'clock in the rear of No. 16 Wycombe Ave. Visitors are always welcome.

Lowell Radio Club (Lowell, Mass.)

Club members of the Lowell Radio Club entertained members from the Interstate

Radio & Research Club of Haverhill, E. M. Robinson, of Boston showed pictures of the action of Vacuum Tubes. Walter Butterworth, Assistant Radio Inspector of the first district made an interesting talk on the enforcement of Government regulations. Refreshments were served during a general Ham Fest in which all indulged.

Rocky Mountain Radio Association

At a recent meeting, Professor Hyslop of Denver gave an interesting lecture on the fundamentals of radio, demonstrating same with tuning forks and pendulums. The Olinger Hylander Radio Club also of Denver was affiliated with the Rocky Mountain Radio Assn. at the last meeting.

The Houston Radio Club

The Houston Radio Club held its Second Annual Banquet and "hamfest" in the Y.M.C.A. Banquet room, on Saturday nite, February 11th. The decorations were unique, and featuring a theme of Americanism. Beautiful silken national flags were everywhere in evidence and the color scheme of the red, white and blue, together with "stars of the ether" decoration was most effective. A perfectly constructed antenna system in miniature was the table motif and with Southern Pine and Spanish moss forming runners for the center of the table. The illumination of the table was augmented by tapers in the national colors. After dinner talks were made by the prominent visiting guests and officers of the A. R. R. L. Among the prominent out of town guests were: Mr. Frank M. Corlett, of Dallas, Division Mgr. of the West Gulf, and A. R. R. L. Director; Mr. L. B. Henson, of the Police and Fire Signal Dept. of Dallas, Asst. Div. Mgr. in charge of Police Broadcasting; Porter T. Bennett, of Dallas Radio Club; W. A. Tolson, Asst. District Supt. East Texas of A & M College, E.E. Dept. and a score of visiting operators. February 12th was devoted to informal get-together meetings and tours of inspection.

Norwich Radio Club

Some of the recent means of increasing interest in radio club organization were carried out by the Norwich Radio Club. Spelling contests or radio terms, Edison questionnaires on radio in general, alphabetical contests of radio terms, etc., are

some of the things which has given the club an increase in membership.

M. I. T. Banquet

The third annual banquet of the M.I.T. Radio Society was held on February 25th under auspices of the Boston Executive Radio Council and the Massachusetts Institute of Technology Radio Society. During the afternoon a splendid exhibit of apparatus held the attention of every amateur who attended. Promptly at 6:15 o'clock 480 joined in and enjoyed a delicious dinner. Several comic movies were shown along with the pictures of the stations that were successful in spanning the Atlantic Ocean during the Transatlantic Tests. Im-

R. R. L. Convention with a resume of what had been done in the past and outlined plans for the future. The convention was held at Lansing, Mich. on Feb. 10th and 11th.

F. D. Fallain of Flint, Mich. acted as toastmaster at the banquet. The delegates were welcomed to the city by Max Henderson, President of the Central Michigan Wireless Association. Mr. Parkhurst, assistant eighth district radio inspector spoke on the coming changes in radio regulations. Immediately after the dinner everyone adjourned to the Majestic Theatre where a program was heard from the Detroit News Service station. Saturday morning Prof. N. H. Williams of the U. of M. gave a



mediately after the banquet some confusion at the door aroused the gang to its feet and who should come bumping through the crowd but The Old Man with a hand bag. He told of his expensive experience with vacuum tubes and when he opened his bag to exhibit his last tube out jumped the cat.

F. D. Webster was toastmaster and he introduced several speakers among which were Sumner B. Young, chairman of the Boston Executive Radio Council, F. H. Schnell, traffic manager of the A. R. R. L., Dr. E. F. W. Alexanderson, chief engineer of the Radio Corporation of America, and Dr. Frederick S. Dellenbaugh of M.I.T. Walker Memorial was the scene of this well managed affair which came to a close near midnight.

Michigan A.R.R.L. Convention

Clyde E. Darr, Superintendent of Michigan opened the first annual Michigan A.

lecture in which he explained by using slides how the ether waves are produced and the necessity for exact tuning in each circuit.

In the evening R. C. Wyckoff of 8YG explained the operation of the C. W. set at 8YG. It is said that many spark sets were on sale following this lecture as the spark hounds had been converted to C. W. (We need a few more conventions like this to lay the spark to rest forever.) T.M.

The Milwaukee Amateurs' Radio Club

The Milwaukee Amateurs' Radio Club was founded in 1917. Up to the time of our entrance into the war the club made great progress in the amateur field but activities were discontinued during the early spring of 1917. The club became active immediately after the lifting of the ban on amateur radio and at the present time is doing world's of good in developing the

amateur situation in Milwaukee by catering to all classes of radio enthusiasts. Meetings are held at 8:00 o'clock every Monday evening except the third Monday in the Trustees' room of the Milwaukee Public Museum. Our limited space forbids publishing the complete history of the club which shows a splendid spirit of team-work. Copies of the history of the club can be had by writing to the club at 601 Enterprise Bldg., 2nd and Sycamore Sts. Milwaukee, Wis.

A Contest

The Arkansas Valley Radio Association, a recently organized association to promote radio throughout the Arkansas River Valley and to aid the American Radio Relay League is holding an interesting contest. The headquarters for this organization are at Wichita, Kansas, where at



the last meeting it was decided to give a cup as a trophy to the station obtaining the longest distance record of actual communication.

Here is a view of the handsome cup

The purpose of this contest is to stimulate interest in radio communication throughout that particular section of the country during the month of April. It is planned that if this contest is successful and meeting the approval of the A.R.R.L. members in that territory, another contest will be held embracing the entire country including Canada. No one will be allowed to compete that does not hold a li-

cense. Special licensed stations and experimental stations will not be considered. For the present contest, stations in Texas, Oklahoma, Colorado, Arkansas, Missouri, Nebraska and Kansas are eligible. Every report must be accompanied by a verification of the station worked, the distance in miles, and a complete description of the station. All reports must be in by May 20th, so that the cup may be awarded by June 1. All communications and reports should be mailed to O. W. Taylor, 1350 South Francis St., Wichita, Kansas.

MORE ABOUT THE TRANSATLANTICS

(Continued from page 39)

regular commercial service. If in a single night Mr. Godley received eighteen American stations, nevertheless for six other nights he did not receive a single one. It is true that with the small power employed and the great distance to cover the obstacles made by atmospherics took on considerable importance. But may we not say that the moonlight had on its part an effect of enormously enfeebling the signals?

"But what is most striking is the curve of the results obtained, the number of stations received having been successively 1, 0, 18, 7, 0, 0, 0, 0. Now December 15th was the day of the full moon and Mr. Godley did not hear anything but feeble signals from the 12th on, including the 15th which was a beautiful moonlight night. We know that short waves are particularly sensitive to the absorbing effects of light. Transmission over a great distance with small power must have made this effect particularly noticeable, and if really long waves are manifestly influenced by the variations in luminosity which eclipses of the sun produce, is it not perhaps reasonable to suppose that a simple moonlight night might make feeble to the point of rendering illegible signals transmitted on a wave length of 200 meters from a distance of more than 6000 kilometers?

"The 'Wireless World' on its part puts forth the hypothesis that the inequality of the reception might be due to large cyclonic disturbances which were produced on the Atlantic during the test. In order to verify this it is about to consult the documents of the Meteorological Office.

"Whatever may come of these facts, further experience will doubtless clear them up and we can still say that our American and English comrades have rendered great service to Science and have helped the cause of radio amateurs. Thanks to them, and thanks to the transatlantic transmission realized under conditions heretofore deemed impossible with only amateurs transmitting as well as receiving, perhaps we shall hear less said of us, and with but a shade of superb disdain, "Oh yes, do you know that this is the man who made himself up a detector out of tinfoil!"

Who's Who in AMATEUR WIRELESS



F. A. Hill

We take great pleasure in presenting to our readers this month Mr. Frederic A. Hill of Savannah, Ga., better known through the air as the wielder of that wicked bug at 4GL. Mr. Hill was born in Philadelphia "some time ago," being too bashful to tell us his age. He had a transitory existence in Mexico for twelve years and journeyed to the Philippines, China, Japan and Borneo for several years in the capacity of a newspaper man and radio bug. He returned to the United States in 1914, locating in Chicago where he operated a quarter kilowatt "sawmill" under the call of 9KJ. In 1915 he removed to southern territory and has remained there since, with the exception of eighteen months on board vessels of the United States Shipping Board. The last two years Mr. Hill has been serving as Shipping Board assistant

(Concluded on page 61)



A. L. Groves

Here's another man we wanted to see. Haven't you been wanting to know all about the man who has supplied us with such detailed information on honeycomb coils and his own famous single layer coils?

Mr. A. L. Groves was born September 11, 1888, at Brooke, Va., and attended the public schools at Brooke and Fredericksburg, Virginia, later attending the Dale Military Academy where in 1904 he brought down the wrath of one of the Professors on his head because he had strung up a telegraph wire between two buildings and the "hum" of the wire kept the Prof. awake. Mr. Groves regrets that they didn't know anything about spark gaps at that time or the "hum" on the wire might have been of a different tone. That was the beginning of his inquiries into the electrical world and he tells us that he can't re-

(Concluded on page 61)

With Our Radiophone Listeners

General Electric Announces New Radio Broadcasting Station WGY

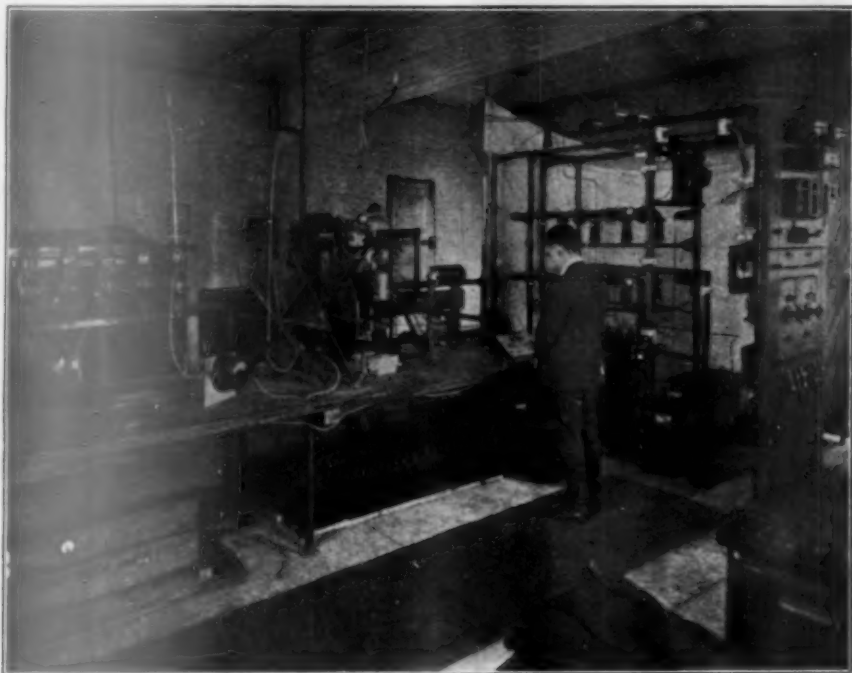
A radio broadcasting station, more powerful than any now sending out programs, has been installed by the General Electric Company at its plant in Schenectady, N. Y.

From the roof of a five story factory building, two towers 183 feet high and spaced 350 feet apart, support an antenna at such height as to give the wireless waves unobstructed freedom in all directions.

no indication of the distance this station may be heard.

Broadcasting stations with but a fraction of the power of the G-E Station have been heard at distances of 2,000 miles or more under favorable atmospheric conditions.

The General Electric station has been licensed to operate on a 360 meter wave length under the call letters WGY. It is equipped with the most modern of radio apparatus, including the multiple tuned



The interior of WGY, Schenectady, N. Y.

This station has not been regularly operated nor has advance announcement been made of the impromptu or test programs sent out, which would cause amateurs to be listening, yet letters have been received from such distant points as Cedar Rapids, Iowa, Minneapolis and Santa Clara, Cuba, the latter place 1450 miles distance, announcing that the programs have been heard. These reports come from operators who, in an evening's experimenting with their receiving sets, have accidentally come upon the waves from Schenectady and are

antenna which, because of its many advantages, has been installed in Radio Central, the world's most powerful commercial station at Rocky Point, L. I., and other transoceanic stations of the Radio Corporation of America.

A three room studio, where the programs are produced, is located in a Company office building, 3000 feet from the transmitting station. One room is used as a reception room for the artists, where they may sit and chat until their time on the program arrives without danger of inter-

fering with what is going on in the studio. The second room is the studio, where a concert grand piano, victrola, an organ and other equipment for the artists are to be found. Here a number of portable microphones, which are commonly known as pick-up devices, can be shifted about to locations best suited for the reception of announcements, musical numbers, or whatever may be sent out. In the room on the opposite side of the studio is apparatus for amplifying the sound waves before they are transmitted by wire to the broadcasting station.



The antenna at WGY

A switchboard in the studio, which lights a red light when the station is in operation thus warning persons in the room that whatever they might say will be sent out to thousands of ears of an invisible audience, is within reach of the studio director at all times. Not until he throws a switch can anything reach the antenna. A telephone attached keeps him constantly informed just how the program is going out and allows him to change position of the artists or microphone if such is necessary to improve the tone quality of the entertainment.

With the exception of the small pick-up devices or microphones and the switchboard, there is nothing in this room to indicate it as different from any musical studio.

In the apparatus room, the sound waves are put through a number of steps of amplification by means of vacuum tubes which increases their volume thousands of times. The amplified sounds are then put into a

wire and sent to the broadcasting station, where they enter another bank of vacuum tubes, known as modulators or molders of the electric waves.

Direct current at a high voltage is necessary for the operation of a transmitting station. To obtain this, a 220 volt alternating current line, which is but little higher than the voltage used for lighting purposes in the home, is boosted to 30,000 volts by means of a transformer. This voltage is then applied to a number of vacuum tubes, acting as rectifiers, which change the alternating to direct current. Placed between the rectifier and the modulator or molding tubes, is a high power oscillator tube. The electric power entering this tube sets the ether into vibration and upon these vibrations the electric waves, molded into shape in the modulator tubes, are sent to the antenna to go out into space.

Ship-to-Shore Telephoning

Thomas H. Rossbottom, General Manager of the United States Lines, is the recipient of hundreds of telegrams and letters of congratulation on account of his pioneer work in using the wireless telephone in communication with the big liner "America" a short time ago.

Maritime history was made by Mr. Rossbottom in his use of the wireless telephone in receiving the report of his Captain and in transmitting orders to the ship. This is the first time in history that the commander of a merchant vessel has made his report to the operator by wireless telephone, and that orders from the operator were transmitted to the ship by the same medium. The occasion for this was the arrival of the Steamship America on March 6.

While the America was still considerable distance from Ambrose Channel Lightship Mr. Rossbottom was connected up thru the powerful station at Deal Beach, N. J. Within ten minutes after the call was made Captain William Rind of the America was on the telephone. After an exchange of greetings Captain Rind told Mr. Rossbottom the speed he was making, and the time he expected to reach Quarantine. Mr. Rossbottom in reply gave his instructions to Captain Rind concerning the special arrangements which has been made with the Public Health officials at Quarantine station for the passing of the vessel beyond the sunset hour.

Mr. Rossbottom and Captain Rind conversed for several minutes. Mr. Rossbottom talked over the telephone at his desk, the one that is normally used in his daily business, and without any special appliances. In talking to the ship Mr. Rossbottom's orders went over the telephone wire to Deal Beach, N. J. There in the big transmitting plant his words were con-

nected to the radio and were shot out from the antenna to the America's aerial and down to a receiving telephone at which Captain Rind listened. Captain Rind's words in reply were sent from the aerial on the steamship to the big receiving station at Elberton, N. J., and then came over the telephone wires to the office of the United States Lines at 45 Broadway.

NEBRASKA WESLEYAN UNIVERSITY STATION 9YD

A broadcasting station has been erected at Nebraska Wesleyan University, University Place, Nebraska, for the purpose of sending out the weather forecast and market reports which are received daily from the Bureau of Markets, at Lincoln, Nebraska. The reports are first sent out by code on a 1-kilowatt spark transmitter with an approximate range of 200 miles and later repeated by telephone which has a range of 100 miles under normal conditions. The schedules are as follows:

Weather forecast and news bulletin, daily except Sunday, 8:50 to 9:00 a.m..

Market and weather forecasts, daily, 4:00 to 4:15 p.m.; and Saturday, 12:15 p.m.

Concerts and lectures Tuesdays and Thursdays, 9:30 p.m.

The station of the Doubleday-Hill Electric Co., WQY, at Pittsburgh broadcasts concerts on the following schedule:

Daily except Saturday and Sunday, 4:30 to 5:00 p.m.

Saturdays, 1:00 to 1:30 p.m.

Sundays, 4:00 to 5:00 p.m.

Night schedule, Monday, Wednesday and Fridays, 9:30 to 10:00 p.m.

The radio telephone is coming into prominence in Australia and a station is now in operation at Dunedin, New Zealand, that has been heard in Wellington, New Zealand by Mr. A. McClay, A.R.R.L. member, a distance of approximately 400 miles. The station at Dunedin was using a very small transmitter but a much larger one is to be installed soon and amateurs all over New Zealand will be able to listen to the concerts.

San Francisco Bay Radio Telephone Schedule

Broadcasted on 360 meters

Every afternoon except Sunday—3:30 to 4:30 P.M., Atlantic Pacific Radio Supplies Co., Concert; 4:30 to 5:30 P.M., Leo J. Meyberg, Press, Market and Concert.

Every night except Sunday—7:00 to 7:10 P.M., Atlantic Pacific Radio Supplies Co. Press, Sports and Foreign; 7:10 to 7:20 P.M., Hotel Oakland, Press, General News; 7:20 to 7:30 P.M., Leo J. Meyberg, Press, Financial and Weather.

Sunday—10:00 to 11:00 A.M., Leo J. Meyberg, Concert; 11:00 to 12:15 A.M.,

Trinity Center, Sermon; 12:15 to 1:00 P.M., Warner & Linden, Concert; 7:00 to 9:00 P.M., Presidio, Concert and Instruction.

Monday—7:30 to 8:30 P.M., Colin B. Kennedy, Concert and Industrial News; 8:30 to 9:00 P.M., Leo J. Meyberg, Concert.

Tuesday—12:15 to 1:00 P.M., Warner & Linden, Concert; 7:30 to 8:15 P.M., Hotel Oakland, Concert; 8:15 to 9:00 P.M., The Radio Shop, San Jose, Concert.

Wednesday—7:30 to 8:15 P.M., Atlantic Pacific Radio Supplies Co., Concert; 8:15 to 9:00 P.M., Herrold Laboratory, San Jose, Concert.



Getting the latest dope by radio.

Photo by Underwood and Underwood.

Thursday—7:30 to 8:30 P.M., Leo J. Meyberg, Concert; 8:30 to 9:00 P.M., Colin B. Kennedy, Concert.

Friday—12:15 to 1:00 P.M., Warner & Linden, Concert; 7:30 to 8:15 P.M., The Radio Shop, San Jose, Concert; 8:15 to 9:00 P.M., Hotel Oakland, Concert.

Saturday—7:30 to 8:15 P.M., Warner & Linden, Concert; 8:15 to 9:00 P.M., Atlantic Pacific Radio Supplies Co., Concert.

Westinghouse Broadcasting News

"Radio Broadcasting News," a weekly newspaper, has been established to mark the first anniversary of KDKA, the Westinghouse broadcasting station at East Pittsburgh, Pa.

About one year ago the Westinghouse company broadcasted its first program
(Concluded on page 61)

Strays



In C.W. transmitting circuits where shunt power feed is used, necessitating a radio-frequency choke, amateurs always have had difficulty. A big honeycomb coil is commonly used for this purpose, altho it is well known that a tuned circuit consisting of a small honeycomb coil and a shunt condenser resonated to the wave length used, is much more effective. However, it's troublesome and the voltages build up terrifically. Here's the answer: use a variometer—any garden variety of short-wave variometer. Simply insert it in any circuit that needs a radio-frequency choke and adjust it to where it chokes the best, which in parallel-supply transmitters is where the antenna current is highest.

Dr. Louis Cohen, chief of Army Radio Research, is said to have perfected a stray eliminator that really works. We hope that some dope on it can be given to the world soon. We understand it has been tested in Army stations in Texas, where by the way they have *some* static. In this case the strays were so severe that it could barely be determined that the other station was transmitting, yet with the eliminator in the circuit the signal could be read nicely and there were no disturbances. Sounds like a dream, doesn't it?

The Navy research folks have discovered a way of eliminating the mush from arcs. This is stright dope. Praise God from whom all blessings flow! The improvement is to be installed in the various Navy arc stations as rapidly as appropriations will permit.

Entries in the competition for the Herbert Hoover Cup for 1921 closed on March 1st. A goodly number of entrants came forward with their material, of course, and the Secretary's cup will be honoring America's best home-made amateur station as soon as an award can be determined.

NOF, sometimes NSF, in Anacostia, D. C., the Navy's amateur-built and amateur-operated station, has been heard "more than once", as Mr. Dow puts it, at 6ZAC in Hawaii, a Great Circle distance of 4780 miles, using buzzer-modulated I.C.W. Fine business, "LC"—congratulations!

Mr. Dow, incidentally, reports 9XM and 9YAE as the latest heard. Soon he's to have a transmitter. Mr. A. H. Babcock has built a duplicate of 6ZAF for him—two 50-watt tubes, self-rectifying—and it was recently tested out in Berkeley and copied OK by Dow, and is now enroute to him by steamer. Perhaps by the time this issue is in circulation 6ZAC will be on the air, and if only a little quiet air can be got on the West Coast to listen for him—Oh Boy! Isn't that a relay for you!

3ZO says that radio men talk about only two subjects—and radio is one of them.

Rumor had it during the Transatlantics that a radiophone signing WQM had been heard in London. This station cannot be located and information concerning it will be appreciated. It was at one time assigned to a phone station of the Kansas Gas & Electric Co. at Wichita, Kansas, but was dismantled at the outbreak of war and has not been in operation there since.

We were surprised to learn while in Washington attending the Radio Conference that the Navy Department in the design and purchase of their equipment are following the proposals of the so-called Paris Technical Conference of last summer, which was a preliminary to the forthcoming International Communications Conference. Our surprise is due to the fact that we don't believe the determinations of the Paris Conference have a ghost of a show of being adopted. They have been completely discredited and repudiated by the commercial and private interests in this country, as being at total variance with the pre-meeting agreements of all U. S. interests. The military representatives of every country dominated the Paris meeting and their findings gave the military interests the big end of everything in radio. By the trend of the times we should say that this viewpoint is quite likely to be an unpopular one by the time the International Conference sits.

6ALE, Lindsay at Reedley, Calif., is now 6ZF, and is putting up a new aerial for his Z wave. He continues to copy 2FP quite often, hearing him several times on the

night of Feb. 17th and copying him practically solid for several hours on Feb. 20th.

Foolish question No. 1,088,333: What organization represented Amateur Radio at the Hoover Conference?

Read 'Em and Weep

On the night of Jan. 20th at 10:30 p.m., F. W. Applegate, 3FP of Trenton, N. J., heard 6ALE and copied a msg. addressed to 2ZL.

6FU, C. F. Filstead of Los Angeles, using one 5-watt tube with 1100 volts on the plate, was heard by 9AIG, Sioux Falls, S. D., on Jan. 28, a distance of 1350 miles.

9AMB, Mr. D. L. Hathaway at Denver, was heard on Nov. 6th by G. C. Farmer on the Str. West Prospect while 3300 miles west of San Francisco or 4300 miles from Denver. One fifty-watt tube with 1250 volts d.c. was used at 9AMB.

Mr. J. B. Cugginano of Brooklyn using a flivver coil has been copied at Hillsboro, N. H., by 1AHF. 250 miles on a spark coil is certainly fine work.

Mr. Wesley Robinson at St. Mary's, Ga. is regularly copying Avalon-Long Beach phone. The first time we have heard of anyone in the east copying it direct.

8XV at Edgewood, Penna., was reported by 6OM of Los Angeles on Jan. 14 and Jan. 20th.

2BEK of Manasquan, N. J., using one 5-watt tube with but 90 volts of B battery on the plate, has been logged several times at 9IN, approximately 900 miles from Manasquan.

2GK heard 6ZA and has confirmed the reception on Jan. 8th. 6ZA used two fifty-watt tubes with an antenna current of 3.8 amps.

It is a well established fact that a C.W. transmitter using A.C. plate supply or poorly filtered rectified A.C. causes considerable local QRM. This of course modulates the C.W. output and for various reasons can be heard over a very broad range of wave lengths within a limited distance. It would be mighty convenient to be able to measure this apparent decrement inasmuch as it is quite a factor in local QRM restrictions. Can anyone furnish any enlightening information on this subject?

5ZQ, ex 5PG, is a new station in Oklahoma. His QRA is W. H. England, Ponca City, Okla.

The old Fessenden 100-kilowatt 500-cycle

synchronous set at NAA has developed trouble in the generator and has not been in use for some time. A 35 kilowatt Telefunken 500-cycle quenched transmitter is being used and it is believed that if it shows itself satisfactory the big old stand-by will be dismantled. The 35 kilowatt set was the one in use at Old Sayville before the war. The antenna current is slightly higher than with the 100 kilowatt set, being around 100 amps. on the present 2650 meter broadcasting wave. Reports indicate that the signals are being heard just as good as with the smaller set but a very peculiar note has been noticed. A tube set has been tested out but no information is available at this time.

1ZE says if you will hook a husky variable condenser across the high-frequency side of your magnetic modulator and tune it down till your antenna current falls off one half, you will eliminate A.C. or D.C. noises and modulate 100 per cent. more volume.

Mr. J. C. Ramsey, 1QR has recently obtained an experimental license for special work under the call of 1XA. Some very interesting work is being carried on and some of the results will be mentioned at an early date.

Most of these would-be news reporters get their tongues twisted when they start thinking of radio. One reporter mentions that the stations instruments were tuned at about 60 meters and that that meant they were tuned to be most receptive to atmospheric disturbances at a distance of 60 meters above the earth. Maybeso!

Some of you fellows that are particularly adept with the pen scratch off a few cartoons and send them into the QST factory.

Someone asked us the other day if the 20 Mule Team borax in a chemical rectifier was to put the kick in it. We replied that that must be where the kick comes from when you get hold of it.

3XM at Princeton, N. J., has recently had a very serious fire, destroying the transmitter completely and a good share of the receiving apparatus. Mr. Richardson informs us that 3XM will not be in operation until next fall. Fortunately no one was injured in the fire, which occurred in the building while the set was in operation. We are sorry to lose 3XM, as it was one of the active third district stations.

Farmer to 1ZE: "Did you get all the rock out down at your place Don't hear any more blatin'".

1ZE: "Blasting—oh—you mean my old coffin spark outfit—ha—I've got some TNT in bottles now".

San Fernando, California, possesses one of those real outsiders that have the interest of Citizen Radio at heart. Willis A. Rowe, who runs a garage, charges the storage batteries of most of the gang there free of charge. A Willis A. Rowe would be a welcome man in most every town.

WESTINGHOUSE BROADCASTING NEWS

(Concluded from page 58)

from KDKA. Interest in the programs became so great that in the latter months of 1921 there came to the company an insistent demand on the part of "listeners-in" that they be informed "in advance" of the programs to be broadcasted from KDKA. With this demand—good-naturedly given, yet insistent—"Radio Broadcasting News" was born. Today, with only a few issues off the press, it is a fixture. It has come to stay because public opinion has demanded it. The birth of this newspaper marks one of the many great forward steps in the marvelous history of the advancement of radio broadcasting.

Radio developments are the chief items published in "Radio Broadcasting News," which derived its first circulation list from those friends of radio broadcasting, who, after "listening in" on the KDKA programs, wrote to the Westinghouse Company expressing appreciation of the broadcasting service.

The publication gives in word and picture news concerning various broadcasting programs and pictures of artists who entertained radio enthusiasts. A feature of each issue is the program to be broadcasted nightly during the week following the date of issue of the newspaper. Copies will be sent to all persons desiring to receive the newspaper who send their names and addresses to the Editor, "Radio Broadcasting News," Department of Publicity, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

A. L. GROVES

(Concluded from page 55)

member when he wasn't trying to figure out the purpose of the little green glass bottles on the poles. After such a notable career he spent several years on his father's farm and finally went to work at Brooke as a telegraph operator in October, 1906, where he has remained ever since. In 1910 a Mrs. Groves appeared on the scene and there are now a couple young Groves' to listen to the radiophones.

In July of 1912 he thought he had completed his first station but found that he was badly mistaken and doesn't seem to have accomplished that yet. A "1500 meter" loose coupler and a crystal detector were the main features and the won-

derful feats of hearing time signals from Key West and copying the west coast naval stations were finally accomplished. Some-time later he picked up the phones and heard a flock of amateurs pounding away and thought it was the usual 600 meter commercial traffic but discovered there were such things as amateurs and thereafter camped on the low waves and became a full fledged amateur, copying middle-west stations, which was a wonderful achievement in those days. Since such early days his station has been a continually changing one, for the better or worse, on first the long and then the short waves,—and he is still at it.

We are indebted to Mr. Groves for much valuable information on honeycomb coil reception on both long and short waves. His well known single-layer coils are in use in many stations today and have frequently accomplished noteworthy receiving records.

In addition to the above qualifications he is an ardent A.R.R.L. supporter and a frequent contributor to QST, wherein many of his articles on receiving have appeared.

F. A. HILL

(Concluded from page 55)

radio supervisor at Norfolk and radio supervisor at Savannah, where this narrative now finds him.

We don't know just how long ago Mr. Hill started to think about radio but he makes mention that his thoughts ran along that line before returning from the East in 1914 so we can see that he has been with the game a long time and is considered one of the old timers at it. He says that he is addicted to late hours and will probably pass out of this life with the phones on.

4GL has made itself heard over many thousands of miles and is one of the best known 4th District C.W. stations. Ships over a thousand miles west of Portland, Oregon, have reported 4GL during favorable conditions and his twitter has been copied in the Atlantic over two thousand miles out from Savannah. Mr. Hill's fist is well known and one needs to only hear a few letters from him to identify it. To our knowledge there isn't a man that can count fast enough to tell how many words a second he sends. 4GL handles a lot of traffic monthly with 3ZY of Washington and is one of the best traffic handlers of his district. The 3ZY-4GL combination can be heard almost every night ripping them off at top speed. No wonder they call him "Chain-Lightning Hill!"

Mr. Hill has recently been elected on the Board of Direction of the American Radio Relay League and we know will be a mighty valuable man in that capacity.

Radio Communications by the Amateurs

The Publishers of QST assume no responsibility for statements made herein by correspondents.



Lower Wavelengths

Ingersoll, Ont.

Editor, QST:—

There has been a great deal said regarding lower wavelengths, but to the best of our knowledge very few amateurs have taken the matter to heart. We are therefore taking this opportunity to outline our personal experience as regards operation below 200 meters.

3GN uses a $\frac{1}{2}$ K.W. Thordarson, 25 cycle, oil immersed plate glass condenser, O.T. of three inch ribbon, and a specially constructed non-sink gap. A new gap is in the course of construction, having teeth three inches in width but otherwise identical with the gap now in use.

When 3GN was first put in operation a modified Round's ground was employed. The wavelength was 192, and radiation from 2 to 2.5 hot wire amperes. It was at once apparent that the apparatus was not doing its best, and improvements were at once commenced.

A counterpoise was erected and used exclusively instead of the ordinary ground. The wavelength was 170 meters, and at the end of five hours testing and adjusting, the reading was 2.7. Then more insulators were used in the counterpoise, leads shortened, and this followed by still more adjustments. Within a week's time the reading had reached 3.0 then 3.2 and finally 3.5. Under ideal conditions we have been able to get a reading of 4.6 to 5 amps., though we now run between 3. and 3.5. All these readings were taken with seven inch coupling, and using an Eldredge Meter. The wavelength, as stated above, was 170 meters.

From the above it is evident that quite as good work is possible on wavelengths below 200 as is being done on 200 and over. However, the low wavelength has a decided disadvantage, which in our opinion it is up to the manufacturers to correct when designing receivers. The radiated wave of 3GN is very sharp, being practically inaudible on 360 meters at a distance of five blocks, even when a four step amplifier is used. In consequence the receiver must of necessity be able to tune efficiently to 170 meters or we are not heard. Apparently there are a great many who are unable to tune this low, or else

do not trouble to listen in on this wavelength believing it is dead.

We do not mean to say that all, or in fact any, of the receivers now on the market are not capable of tuning to 170 or less. We do find however that they are not being built for as efficient operation on 140 to 170 as they are from 170 to 250. This is doubtless natural, because so very few stations are working between 140 and 170 meters.

We therefore believe that the answer to the more general use of lower wavelengths lies with the manufacturers of receivers, and especially the prominent advertising of the sets themselves. We shall watch for developments with much interest.

Everyone is aware of the fact that very few spark stations are working below 180 meters. Consequently there is a minimum of QRM and the use of these lower wavelengths offers a new field for amateur communication. It would certainly avoid so much jamming on 200 meters; and need we also mention the little point of keeping within the law?

A few days ago we received a letter a most sarcastic and disparaging letter, from a certain flying officer located some one hundred miles away. He informed us in no uncertain terms that we were on 360 meters because we seriously interfered with phone reception from KDKA. Now we take pride in the fact that we have been able to get good results on 170 meters, with a very low decrement, and consequently we were at first incensed at what appeared to be a deliberate falsehood. However upon considering that he was quite evidently new to the game we decided to look into the matter and find out where the trouble really lay. We verified the wavelength and decrement, and then began inquiries. What we have found out will likely be of interest to the Westinghouse people.

Mr. Gowan, of Kitchener, has already noted that KDKA has a double wave, or perhaps to be exact a harmonic. We have verified this report, and several local amateurs have noticed the same thing. This second wave or harmonic is on 170 meters or else very near it, and the flying officer above mentioned made an error in his conclusion that it was 3GN who was on 360 meters.

For our peace of mind we would like to hear from the Westinghouse people, as the second wave or harmonic is more than audible, and we haven't the time to explain the thing to every would-be amateur who thinks he has something to complain about.

Thanking you for your valuable space, we beg to remain

Very truly yours,

H. R. Byerlay, 3GN.

Cages vs. Flattops

1814 East First St.,
Duluth, Minn.

Editor, QST:—

In the article in the January QST describing the antenna system at 3DH, Mr. Richardson states that the current in the conical cage antenna is divided evenly among the six wires, "whereas, if a flat top were used, approximately 60% of the energy would be found in the two outer wires." He also says that the cage aerial gives better results than the aerial used previously. He implies that the superior efficiency of the cage aerial is due to the uniform distribution of current, but a little figuring will show that it cannot be. A six wire flat top aerial having 60% of the current in the two outer wires would have about 33% higher resistance than an equivalent cage the resistance referred to is that of the horizontal portion only, without leadin or counterpoise). If two aerials, one a flat top and the other a cage, consisted of six wires of No. 12 copper 50 feet long, the h.f. resistances would be approximately .166 ohms and .125 ohms respectively. If the current in the leadin was 2.5 amperes (250 watts input in a 42 ohm aerial) the mean value of the current in the horizontal portion would be between 1.5 and 2.0 amperes. Taking the larger value, the resistance loss would be .666 watts in the flat top and .500 watts in the cage. A grand total of one-sixth of a watt is saved by the cage antenna!

With an input of 250 watts, the antenna at 3DH radiates 80 watts and dissipates 170 watts in the form of resistance and dielectric losses, according to data given by Mr. Richardson. Therefore the conical cage antenna is .1% more efficient than a flat top antenna of the same dimensions.

The symmetrical arrangement of the wires in a cage aerial equalizes their inductances, but it does not equalize their capacities, and so cannot equalize the currents in them. The only way to make the currents absolutely equal would be to build a cylindrical counterpoise, and put the cage aerial at the center of it. A better plan would be to build a flat top aerial with small wire in the middle and large wire at the edge, the size of each wire being proportional to the current it carries.

I have no quarrel with anyone who makes a cage leadin, as that form has lower resistance than the usual loosely twisted bunch of wires; but I believe that a man who builds a cage aerial is wasting his time.

Sincerely yours,

R. A. Braden.

(Hop to it, fellows—let's have it out and learn what we really think is best—Ed.)

Re Our January Editorial

New York City

Editor, QST:—

I cannot but take exception to the attitude expressed in your editorial headed *Excelsior* in the January QST. I do not know who the "eminent radio engineer" mentioned may be, but he cannot be very eminent if he made the remarks credited to him. This is shown in part by the fact that Mr. Edwin H. Armstrong, one of our best radio engineers, has given a great deal of time and effort to putting the amateur Transatlantics across, which he would have been hardly likely to do, had he thought there was no chance of success. Everybody knows that exceptional distances on extremely small powers can be obtained under certain conditions. It must be remembered that the first transatlantic, to Glace Bay, was carried on with an actual radiated energy of a few hundred watts in conjunction with an untuned crystal receiver. The editorial in question gives the impression, which I can hardly believe to be true, that you do not differentiate between amateur service and commercial service. Transatlantic commercial service, to compete successfully with the cables, must of course give twenty-four-hour-a-day service three hundred and sixty-five days a year. Any real radio engineer will tell you that in long distance transmission, the power required for continuous service may be several thousand times the power necessary to get through under "decent atmospheric conditions," to quote your article.

One of the writer's stations, WSA, has on several occasions worked ships at 5000 miles, yet would you yourself install a 10 K.W. synchronous transmitter operating on 600 meters for commercial service over this distance? Do you suppose Dr. Alexander-son would have allowed the Radio Corporation to spend several million dollars at Port Jefferson if the same results could be obtained with six 5-watt tubes and a dozen pieces of 2x4? Also do you imagine that the best of the short wave stations that got across could handle much traffic in the average August mid-day?

I do not for one moment wish to belittle a splendid achievement, but I do object, and I think justly, to the attitude that radio amateurs have done something con-

sidered impossible by radio engineers of standing.

Let me emphasize once more that the commercial radio engineer is interested in general in twenty-four-hours-a-day service, while the amateur is, naturally, interested primarily in working the greatest distance under the extremely limited conditions as to power and wavelength which he is allowed. The radio engineer who states that communication cannot be obtained under the conditions of your transatlantic test is not worthy of the name of radio engineer, nor is the amateur who says that such communication is practical, money-making commercial communication, worthy of the honor of being called such.

Very truly yours,

Bowden Washington

Chief Engineer,

Independent Wireless Telegraph Co., Inc.

Who Is Signing 7AJ?

3015 North 26 Street,
Tacoma, Washington

Editor, QST:—

Who is the bird in the east who signs 7AJ? I have received reports at 7AJ being heard by seven different men in the east and each time circumstances have proven that it was not the writer's station that was heard.

Several months ago I received a card from 8LX, saying that he, 8CH, 8ASF, and 8LF had heard 7AJ on several occasions. Neither the wave, time, nor tone agreed with mine. About a month ago I received a card from 9BMN, saying that he had heard my C.W. I have no C.W. set. A week ago I got another card from the op at 8YAA and 8AXC, stating that he also had heard my C.W.

I do not think that all these men are at fault, they undoubtedly heard a 7AJ but what 7AJ? Nigger in the woodpile somewhere.

I shall be duly thankful to anyone who can tell me howcum.

Very truly yours

F. B. Mossman, 7AJ.

Hooray!

DEPARTMENT OF COMMERCE

Bureau of Navigation
Washington, February 2, 1922

Editor,
American Radio Relay League,
Hartford, Conn.
Sir:

This office has received your letter of the 28th ultimo, suggesting that the street addresses of owners of special land stations be published in the "List of Radio Stations of the United States," in addition to the names of the cities in which the stations are located.

In reply this office desires to thank you for the suggestion and beginning with the "Radio Service Bulletin" for this month, which is supplemental to the list of stations, the full addresses of the owners will be published.

Respectfully,

A. J. Tyrer,
Acting Commissioner.

Humidity and Fading

209 So. State St.,
Ann Arbor, Mich.

Editor, QST:

An old timer can hold his peace only about so long and the last copy of QST has lead me to express some of the ideas that I've wanted to get off my chest for a long time!

The immediate cause of this out break is the article of Mr. Jacob Jordan in the December issue. Mr. Jordan's data while most interesting are almost worthless. He has hit, I believe, one of the most important causes of fading. That is to say the fading that is due to the variation of wave length and which may be corrected by re-tuning the receiver. The other types of fading I believe are not so easily accounted for.

Mr. Jordan does not attempt an explanation of the variation in wave length but I have always believed that this variation was due to the variation of the dielectric constant of the space between the antenna and the conducting layer. In our case it is the water vapor in the air. The dielectric constant of the suspended water vapor would be anywhere between 80 and infinity, depending on how pure the water vapor was. It can easily be seen that the capacity of the antenna would be increased at least 80 times if the space were filled with water; hence the wave length would be increased 900%, other things remaining the same. Isn't it logical to believe that a reasonable amount of water in suspension would alter the wave length a noticeable amount? If Mr. Jordan had given us the absolute humidity instead of the relative humidity I should venture to say that we would find that the change in wave length would vary roughly as the square root of the ABSOLUTE humidity. It is to be understood in the above that I am not trying to explain any type of fading except the type that can be corrected by retuning.

Another point that has interested me was the power factor question. I believe that both parties are right for after all it is just ones point of view. If one is outside the circuit and considering the freely oscillating circuit as a whole then I should say that the P.F. was unity. On the other hand if we are within the circuit and talking about any particular part of it I should say that the P.F. was approximately zero.

Here is a point in connection with this that reduces some of the arguments to an absurdity. In an ordinary radio circuit the P.F. is approximately equal to the phase displacement and the decrement is "pi" times the phase displacement or as a very good approximation, Decrement = 3.1416 times Power Factor.

In light of the above do our friends on the Pacific Coast still insist that they want their P.F. as large as possible? If they do they must necessarily demand that their decrement shall be as large as possible. The question is: do they?

If anyone doubts the logic of this I refer them to an article by Dr. Dellinger in the Feb. 1919 issue of The Proceedings of the Institute of Radio Engineers.

There! I feel greatly relieved.

Sincerely yours,

Ross Gunn, B.S.

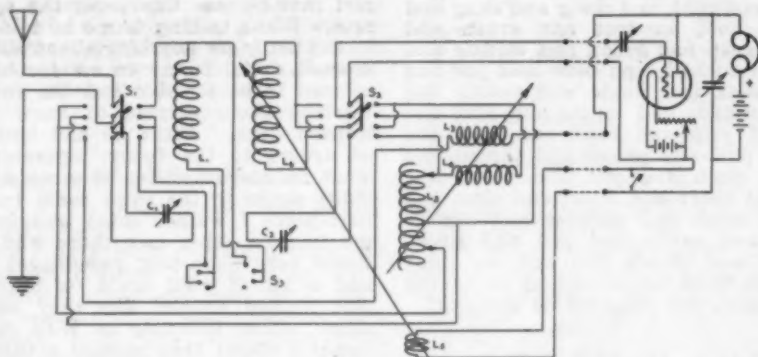
Pre-war 8JA and 8ZO.

A Combination Tuner

819 Sheridan Ave.,
Akron Ohio, R #24.

Editor, QST:

Am enclosing a diagram that shows how to combine Mr. J. L. Reinartz's CW tuner with my coil set. Mr. Reinartz's tuner was described fully in the June 1921 QST.



I decided to try the tuner and didn't care to go to the expense of purchasing any new condensers so combined the tuner with my coil set. The diagram is self-explanatory but I will give the names of all the instruments to be sure that everything is clear.

S_1 and S_2 are cam (anti-capacity) switches while S_3 is the usual primary condenser switch. C_1 primary condenser and C_2 secondary condenser. L_1 primary coil; L_2 secondary coil. L_3 is the tickler and should be cut out when using the CW set. L_4 is the main CW inductance, L_5 the plate inductance, and L_6 the grid inductance. L_7 , L_8 , and L_9 are the CW inductances and can readily be made by anyone by following Mr. Reinartz's directions.

The two cam switches should be coupled together so that one knob will work both, having the CW wires, say on the left, and the ones from the coil on the right.

Room can be found on almost any panel for the CW inductances as they occupy very little room. The same can be said of the cam switches so there is no excuse for not having a good CW tuner right in your shack, at very little expense.

Hope that you will find this of some interest

Respectfully yours,
E. Ulmont Fisher.

More on Tuning Honey-Combs

Wooster, Ohio.

Editor, QST:

After reading Mr. Jessup's letter in December QST concerning honeycomb tuning it seems to me that he doesn't say as much as he should about primary tuning. It is really quite an art to learn to correctly tune the primary and adjust the primary and tickler coupling on any wave length, CW or spark, and I believe that most of those who think that good work can not be done on honeycombs have never learned to use them correctly.

When the primary is tuned to the same wave as the secondary it is very hard to make the tube oscillate, and it is usually

possible to put the tickler coupling to maximum and with the primary coupling very loose get very sharp tuning and strong regeneration. We will consider the primary and secondary each tuned to 200 meters, and the tickler tightly coupled. With the primary tightly coupled the set will oscillate below 190 meters and above 210. By varying the secondary condenser the station is found which we will consider is on exactly 200 meters. The primary coupling is next loosened, which will increase regeneration. When the primary coupling is very loose the tube will oscillate at all waves, but with a little tighter coupling it will oscillate only below 197 and above 203 meters. The looser the coupling the

narrower the space that the tube does not oscillate and consequently the greater the regeneration and the sharper the tuning. Slight adjustments of the primary condenser may be necessary to keep the primary tuned exactly to the incoming signals.

If the tube oscillated too easily when tuned this way loosen the tickler coupling slightly.

The selectivity of a tuned plate circuit can not be compared with that of a honeycomb circuit that is carefully tuned. An operator who doesn't know just what wave his primary has been tuned to may be surprised to find how small a coil is needed to get the primary down to 200 meters, but even 10 turns in the primary is enough to give ample coupling when the primary is carefully tuned.

If there is no condenser across the tickler a coil of 75 or 100 turns will usually be necessary.

Very truly yours,
Victor Andrew, 8BPP.

A Love-Letter

Editor, QST:

Why is it that every Arc Station has to fizz and spit and ding and dong and clong and bang and buzz and bizz and beller and wail and pant and rant and howl and yowl and grate and grind and puff and bump and click and clang and chug and moan and hoot an toot and crash and grunt and gasp and groan and whistle and wheeze and squawk and blow and jar and jerk and rant and jingle and twang and clack and rumble and jangle and ring and clatter and yelp and howl and hum and snarl and puff and growl and thump and boom and clash and jolt and jostle and screech and snort and snarl and slam and throb and crink and quiver and rumble and roar and rattle and yell and smoke and smell and shriek like hell on every wave length from ten meters up to infinity and then can't get their traffic through?

A. Victim.

A Trip to the U.S.S. Ohio

Editor QST:—

While in Philadelphia a short time ago, I had the honor of visting the Philadelphia Navy Yard. In the course of the day we went aboard the Navy radio ship the U.S.S. Ohio. At that time I thought it was just an ordinary battleship, but in a few minutes, much to my surprise I found out that it contained a lot of interesting radio apparatus and some interesting radio operators. Walking down one of the aisles, I heard a voice saying this: "When in the course of human events it becomes necessary for IB*SHIR*&*! (explosion) and at first I thought it was a school room. You can imagine my surprise when I peeped in the door and beheld

a blond haired fellow in very ragged overalls bending over a piece of apparatus and what he was saying to it would never be found in the Congressional records. It was a startling array of apparatus that greeted my eyes. It appears that this chap, who's name I afterwards found out was Dan-nals, had been working with some kind of a transmitter and it would not 'mote! That was the cause of the explosion. After sitting in the room for a while talking to a fellow by the name of Garrett (who was born on Staten Island of very ancient Dutch parentage) the blond haired one started again; "Four score years and ten ago," ??!Z\$C!*!*BF&5 another explosion. By this time the air became very warm and I thought I better move. I then wandered around until I heard the old familiar quenched spark hissing and brave like I started to investigate where it was coming from. Thru a doorway I crawled and behold: what mine eyes seen were enough to make any amateur turn green with envy. Arcs-sparks and gosh only knows what. After straightening up I was afraid to move. All kinds of sets, rubber mats on the floor and a tall, dark haired individual giving orders to some young chaps who seemed busier than a one armed paper hanger with the itch! This tall gentleman's name I afterwards found out to be Manuel and that he was Czar over the spark and arcs. While talking to me he told me that he did not know anything about radio which seemed awful funny to me for his orders seemed to be sensible and the young men working there seemed to know what he wanted done. After he had issued a lot of orders to the future operators about what he wanted done, he escorted me upstairs again to the ships radio room (The first place I walked into) and introduced me to some other men there who were no doubt very important personages for they had a lot of gold braid on their sleeves and walked around like they owned the ship. After listening to WJZ roaring in (only 5 steps) they started a tube set going, which used two small P tubes for puncturing the air. While looking at the ammeter, I saw 13 amperes registering and thought it was out of order or crazy with the heat, but they assured me it was in good health and working O.K. Visions of my one little amp. in the air came back to me. It was just getting interesting when in breezed a fellow with more gold braid than any of the rest and they all saluted with a smile and became very humble in manner so I breezed out before they thru me out. Well this is all I lamped on this visit but when the opportunity presents itself again, I am going to pay them another visit.

Yours 'till the grid leaks

B. B. Attery.

Hi!

East Pittsburgh, Pa.
February 1, 1922Mr. Harold Hotaling,
106 Forest Street,
Gloversville, N. Y.
Sir:

In reply to your recent card in which you mention the effect of Northern Lights on Radio, I will state that this phenomena never effects radio waves. It usually causes trouble to telephone and telegraph circuits, but so far has not been noted on radio work.

Yours very truly,
Westinghouse Elect. & Mfg. Co.,
C. W. Horn,
Radio Service.

Lower Wavelengths

Huntington Park, Cal.

Editor QST:—

Concerning the article by Mr. Forant in the Dec. QST about spark coil transmission, how about 150 meters for the work? It would be possible to work thru any sort of QRM on 200 by using this wave. What say?

If some of these transformer hams and the transformer stations that aren't hams would install a spark coil set operated on 150, 175 or even lower waves to do their local work it would reduce the QRM on 200 VERY CONSIDERABLE, besides I want someone to work with down there.

Yours for less QRM

Frederick J. McClung.
6ASQ

Absorption Modulation

Lyndhurst, New Jersey

Editor, QST:—

Of late I have been reading quite a bit about the now famous "1DH hook up" for a small powered phone set, but up to date have not seen anything about getting perfect speech using the absorption loop method of modulation.

I have for the past three months been experimenting with a single tube set as described in August 1921 Issue of QST and find that by having fewer turns in the grid coil and putting it over the main inductance the radiation is greatly increased.

I am at present getting nine-tenths (0.9) of an ampere radiation with 350 volts on the plate; 35 to 45 milliamperes space current and 1.3 amperes at 7 volts on filaments.

For modulating the voice I put a complete turn around the grid coil and attach it to the hand microphone. It seems that the grid coil acts as a transformer when used in this way; there is no loss in radiation as when using the loop around the main inductance and if any loss is noticed

it might be one half of a tenth, but that returns when the transmitter is spoken into.

I am using rectified A.C. for high voltage, using an old transformer with a split winding and an electrolytic rectifier.

Stations 20 to 25 miles away tell me that there is no hum, or in fact, anything that might distort the voice.

Yours respectfully,

Fred Suefert, 2AOG.

A Storm Relay Route

DURING the latter part of February a terrific ice storm and blizzard passed over Minnesota and the adjacent territory and completely destroyed all of the wire communication connections of Minneapolis and St. Paul with the outside world. Amateur radio came to the rescue and established a remarkable network throughout the district and restored communication with the outside world.



All wire service went out on the evening of February 22d at 6 p.m. The "Minneapolis Tribune" appealed to 9XI, University of Minnesota, to get news for its morning issue and to make an attempt to get in communication with the outside world. Accordingly 9XI fell to and succeeded in raising 9ZJ in Indianapolis thru terrific QRM, but before any copy could be secured from Indianapolis he was forced to break off due to increasing atmospheric conditions. At 2:00 a.m. 9XI was in communication with 9AXF at Chicago but before any traffic could be handled, the Associated Press had gotten a line through to Chicago, via Vancouver, Denver and St. Louis and were handling their traffic over that roundabout route. This line too went out early in the morning and the entire A. T. & T. service with it. The telephone people set out to repair the lines immediately but requested that some of the Minneapolis and St. Paul stations get in touch with

(Concluded on page 75)

Calls Heard



HEARD DURING FEBRUARY Unless Otherwise Specified

Amateurs reporting lists are requested to see instructions appearing at the head of this department in previous issues, and to observe the following additional instructions.

(4) In order to distinguish between spark and C.W. stations, list spark stations from 1 to 9 in the usual manner, and then make a second paragraph in identical form listing the C.W. stations.

W. E. Clyne, Cristobal, C. Z.

Spark: 5MI, 5XU, 5ZA, 9YC.

C.W.: 1AZW, 1BDL, 1BKQ, 2CCD, 2XI, 3FS, 3HG, 3ZY, 4CO, 4ID, 4ZE, 5ZAA, 8BEP, 8BUM, 8AGZ, 8CLD, 8ABV, 8WH, 8GV, 8AXK, 8XK, 8AIM, 8XV, 8ZZ, 9AL, 9AYS, 9DCF, 9FM, 9NX, 9FS, 9XAG, 9ZAC, 9ZL.

Can. 3JI, Toronto, Ont.

C.W.: 1FB, 1IN, 1PT, 1QN, 1QP, 1QR, 1QZ, 1TH, 1UN, 1XA, 1ZE, 1AAP, 1AFV, 1AGI, 1ARY, 1AVI, 1AWB, 1AZW, 1BCF, 1BEA, 1BEP, 1BES, 1BFU, 1BKQ, 1BUA, 1BWJ, 1CKE, 1CIK, 1CIT, 2BB, 2BG, 2CT, 2EH, 2FF, 2OF, 2SQ, 2VA, 2VH, 2AER, 2AJF, 2AKO, 2ALR, 2AMO, 2ANZ, 2AWA, 2AWF, 2BBB, 2BCF, 2BEA, 2BEB, 2BCH, 2BLT, 2BNZ, 2BRC, 2BUW, 2CCL, 2IDZ, 2BG, 3CA, 3CG, 3FB, 3FS, 3HG, 3HJ, 3IZ, 3KM, 3NH, 3RD, 3RF, 3SQ, 3YQ, 3ZU, 3ZY, 3AAD, 3AAY, 3ADT, 3AHK, 3ANI, 3ANY, 3APA, 3APQ, 3BEC, 3BFT, 3BLF, 4BK, 4BQ, 4EO, 4EW, 4FT, 4GL, 4ID, 4FV, 5IX, 5NZ, 5AC, 5CG, 5CL, 5HJ, 5IG, 5IR, 5JS, 5JU, 5LW, 5NE, 5NI, 5OA, 5OH, 5OS, 5PX, 5QM, 5QY, 5SP, 5UK, 5VI, 5WR, 5XK, 5XV, 5ZG, 5ABO, 5ACF, 5AHR, 5AFN, 5AGI, 5AID, 5ALB, 5ANI, 5AOB, 5AOG, 5ARI, 5ARU, 5ARV, 5ASV, 5AUO, 5AWP, 5AWY, 5AWZ, 5AXC, 5AXK, 5AXZ, 5BBK, 5BDO, 5BFX, 5BLW, 5BMA, 5BMY, 5BOX, 5BQF, 5BQL, 5BUM, 5BWH, 5BZY, 5CAG, 5CAH, 5CAV, 5CAZ, 5AGT, 5CLN, 5ZAE, 5EA, 5HK, 5IU, 5JL, 5KP, 5LE, 5LQ, 5LT, 5US, 5WK, 5WO, 5XM, 5ZG, 5AAS, 5AAY, 5AEJ, 5AFH, 5AIV, 5AJA, 5AJH, 5AJP, 5AKD, 5AKR, 5ALS, 5AMU, 5ARK, 5ASB, 5AWM, 5BJB, 5BRL, 5DAM, 5DTS, 5DTS, 5DYN, 5YAM, Can. 2BG, 3SJ.

Spark: 1AW, 1CK, 1CZ, 1RV, 1ADC, 1ARY, 1BDT, 1BHO, 1BOQ, 1BVB, 1CHJ, 2BK, 2BM, 2BY, 2CL, 2EL, 2FD, 2JU, 2KM, 2OM, 2SZ, 2TS, 2WY, 2ABM, 2ACW, 2AHU, 2AWF, 2AXK, 2BTJ, 2CIC, 2AC, 2DM, 2HG, 2QP, 2UD, 2VS, 2XM, 2AIC, 2AJD, 2AQH, 2ARM, 2ARN, 2AUW, 2BJT, 2BQ, 2EA, 2GN, 2CP, 2FA, 2FS, 2JJ, 2KY, 2LB, 2LI, 2NO, 2NZ, 2SQ, 2RQ, 2SP, 2TT, 2UC, 2WO, 2XE, 2ADO, 2AFB, 2AFG, (2AHQ), 2AGK, 2AHQ, 2AHS, 2AID, 2AIO, 2AJT, 2AKQ, 2AMZ, 2AOT, 2APB, 2ASL, 2AVT, 2AUE, 2AWP, 2AXX, 2BAC, 2BAZ, 2BFH, 2BOP, 2BYP, 2CAY, 2CHJ, 2AV, 2BP, 2CP, 2JQ, 2TO, 2UH, 2VL, 2YB, 2YQ, 2ZI, 9AAR, 9AGR, 9AIS, 9AMS, 9AZE, 9DIW, 9DWP, Can. 3BA, 3GN.

Can. 2DK, Sutton, Que.

Sparks: 1AAX, 1ADC, 1ADL, 1AEV, 1AFZ, 1AHF, 1AHL, 1AIT, 1AKC, 1APO, 1ARY, 1ASF, 1ASZ, 1AZK, 1AZW, 1BCF, 1BEP, 1BDL, 1BEP, 1BGC, 1BHR, 1BIR, 1BLE, 1BJE, 1BJS, 1BQL, 1BRQ, 1BTL, 1BVB, 1CHJ, 1CK, 1COK, 1DZ, 1GM, 1HK, 1IA, 1LZ, 1QD, 1QP, 1RV, 1SD, 1SN, 1UN, 1VB, 2AID, 2AXX, 2ARB, 2AER, 2AIM, 2ARM, 2AAF, 2AWF, 2ABM, 2ARK, 2BM, 2BQ, 2BSC,

2BBN, 2BK, 2BJO, 2BY, 2CHJ, 2DA, 2EL, 2FP, 2JZ, 2JU, 2OM, 2OO, 2TU, 2XM, 2XK, 2AQR, 2BFU, 2CG, 2DH, 2DM, 2FO, 2HG, 2HJ, 2XM, 2UQ, 2YP, 2ZO, 4EA, 5ZA, 8ACF, 8AFA, 8AFS, 8AMB, 8AMZ, 8APB, 8AXO, 8AYN, 8BFX, 8BUM, 8CG, 8RC, 8TC, 8NI, 8VW, 8XE, 8XA, 8XG, 8ZA, 8ZG, 8ZO, 8ZP, 9YB, 9YC, 9ZN.

C.W.: 1ARY, 1ASF, 1AVR, 1AYL, 1AXI, 1AZW, 1BDL, 1BEA, 1BES, 1BKQ, 1BQL, 1BRQ, 1BSD, 1BWJ, 1BWP, 1CAK, 1CGS, 1CLZ, 1EZ, 1IN, 1QF, 1QN, 1QP, 1PT, 1RD, 1RJ, 1TS, 2AAB, 2AKO, 2AWL, 2AYV, 2BFZ, 2BJO, 2BSC, 2BYW, 2CBT, 2FP, 2ADX, 2AQR, 2CC, 2FS, 2HJ, 2GC, 2ZO, 2ADG, 2AGZ, 2AWY, 2BMA, 2BUM, 2JS, 2JU, 2ZZ.

Can. 3GG, Timmins, Ontario

1AWB, 1ARY, 1AYW, 1BDL, 1BUA, 1BWY, 1IO, 1MX, 1TS, 1XM, 2AAB, 2BAK, 2BEJ, 2BTJ, 2BFX, 2CBG, 2FF, 2QL, 2TS, 2VA, 4ID, 4FT, 5UU, 6FV, 6ASE, 6AIM, 6AWY, 6AXK, 6AQH, 6APT, 6ALY, 6AUO, 6AIZ, 6BU, 6BFX, 6BBK, 6BEP, 6BUQ, 6BZY, 6BDO, 6BOX, 6BK, 6CP, 6CBR, 6CGM, 6EA, 6FA, 6HJ, 6KP, 6NI, 6PX, 6RH, 6SP, 6TK, 6UK, 6UC, 6VY, 6YV, 6ZG, 6AIV, 6AF, 6AKP, 6AGR, 6AJB, 6AAV, 6ATM, 6AY, 6BED, 6BJV, 6DBQ, 6DFX, 6DV, 6DZQ, 6DNT, 6DZY, 6DWP, 6DKV, 6DXT, 6EA, 6GK, 6IO, 6IV, 6KP, 6LW, 6LE, 6OL, 6QE, 6TV, 6UL, 6VL, 6WK, 6YQ, 6YAK, 6YO, 6YB, 6YC.

3IL, Kingston, Ont.

C.W.: 1AAD, 1AFV, 1AGI, 1AJS, 1APP, 1AVI, 1AWB, 1AYL, 1AZW, 1AZX, 1ADC, 1BDL, 1BEA, 1BES, 1BH, 1BHO, 1BJH, 1BJO, 1BKQ, 1BKR, 1BOQ, 1BQE, 1BRQ, 1BSD, 1BSN, 1BTL, 1BUA, 1BYK, 1BWJ, 1CAK, 1CIK, 1CIT, 1CMK, 1CQO, 1EZ, 1IN, 1QP, 1RD, 1TS, 1WT, 1XM, 1ZE, 2AAB, 2AJF, 2AJP, 2AL, 2AQF, 2AWL, 2AWS, 2AYF, 2AYV, 2BBB, 2BB, 2BEA, 2BEB, 2BEH, 2BGH, 2BML, 2BYT, 2BNZ, 2CAV, 2CC, 2CCU, 2CGO, 2FP, 2HI, 2JW, 2KP, 2NQ, 2NZ, 2OG, 2SQ, 2AQR, 2AFB, 2AI, 2AJD, 2AL, 2AP, 2ADI, 2BEC, 2BG, 2CZ, 2CC, 2FS, 2HJ, 2HG, 2RW, 2SQ, 2EW, 2GL, 2HJ, 2IN, 2ADJ, 2AP, 2AGZ, 2AIM, 2AIO, 2AOD, 2AQF, 2AQR, 2AWN, 2AWZ, 2AXY, 2BEF, 2BFX, 2BK, 2BMY, 2SEJ, 2XK, 2XV, 2XXF, 2YV, 2AKR, 2AIV, 2AJA, 2BRL, 2BXH, 2BY, 2CFP, 2ED, 2EM, 2HJ, 2NI, 2ALS, 2AZ, 2ADG, 2BET, 2BV, 2BEJ, 2HA, 2IO, 2NI.

Spark: 1ADL, 1ADP, 1FZ, 1AKZ, 1APJ, 1ARY, 1BJE, 1BOQ, 1CZ, 1EA, 1NZ, 1RV, 1ZP, 2ARD, 2ARK, 2ACW, 2AHU, 2AJW, 2BAA, 2BNZ, 2BW, 2BOY, 2FP, 2OM, 2QW, 2RP, 2TJ, 2UH, 2XK, 2ZW, 2ARM, 2DM, 2EM, 2FB, 2GM, 2HJ, 2TA, 2UQ, 2AFY, 2AK, 2AKQ, 2AI, 2AJ, 2AWP, 2BO, 2BU, 2BX, 2TE, 2XE, 2XM, 2AET, 2AM, 2AGR, 2BP, 2BHR, 2DW, 2KI, Canadian (3HE), 3HF, 3HN, 3NE, 3KG.

Can. 4CB, Morse, Sask.

Spark: 5BY, 5FM, 5FO, 5IF, 5KI, 5MK, 5XB, 5XU, 5YG, 5APH, 5ATQ, 5AWH, 5BIG, 5IC, 5J, 5QR, 5XH, 5ZAM, 5BD, 5BS, (7CC), 7CD, (7CK), (7EX), 7GD, 7GJ, 7HW, 7IY, 7JD, (7LY), 7ME, (7MP), 7NR, 7NZ, 7OT, 7TJ, 7WG, 7XA, 7XB, 7YA, 7YG, 7YJ, 7YL, 7ZJ, 7ZM, 7ZO, 7ZP, 7ZT, (7ZU), 7ZV, 9AAP, 9ABV, 9ACB, 9AFZ, 9AGN, (9AIG), 9ALP, 9AMU, 9ANF, 9DOW, 9ARZ, 9ATM, 9AUF, 9AUZ, 9AVC, 9AVS, 9AVZ, 9AWR, 9AYW, 9BBM, 9CA, (9DEH), 9DEW, 9DEG, 9DKG, (9DOC), 9DNC, 9DSO, 9DZQ, 9EX, 9HI, 9HT, 9INF, 9ISM, 9LW, 9MR, 9NR, (9PI), 9PW, 9RY, 9SA, 9SY, 9TI, 9TY, 9UU, 9WI, 9XI, 9XV, 9YAJ, 9YB, (9YAK), 9ZX, Can. 4AC, (4AO), (4BV), 4DN, 4EI, 9BD.

C.W.: 4BQ, 4FT, 4ZE, 4BY, 5AAM, 5PU, 5ZA, 5ZX, 6AAT, 6AIF, 6APE, 6ASV, (6AWT), 6EN, 6KA, 6KS, 6XAD, 6ZA, 6ZAM, 6ZF, 6ZZ, 7AWS, 7ABS, 7HW, 7JD, 7LU, 7NF, 8CLD, 8LY, 9AAO, 9AAV, 9ADO, 9AJA, 9AJF, 9AJH, (9AJP), 9AJR, 9AKB, 9AKR, 9ALS, 9ALU, 9AM, (9AMB), 9ANS, 9AS, 9AUL, 9AVA, (9AWM), 9AXA, 9AXF, 9AYS, (9BBF), 9BIZ, (9BJI), 9BJV, 9BSG, (9BVY), 9BTT, 9BUG, (9DCF), 9BD, 9DFA, 9DGG, 9DJM, 9DKY, 9DNG, 9DOF, 9DQM, 9DSW, 9DTH, (9DTM), 9DTS, 9DTW, 9DUN, (9DVA), (9DZQ), 9EA, 9EE, 9FM, 9JL, 9KP, 9LJV, 9NG, 9NN, (9NX), 9OO, (9PI), (9PS), 9URI, 9WD, 9XAV, (9XAQ), (9XI), 9XJU, 9YG, 9YS, 9ZAC, (9ZAF), 9ZE, (9ZIF). Can. (9BD).

IDZ, Medford, Mass.

Spk.: 1CE, 1IL, 1QO, 1YB, 1ADL, 1ARY, (1BCF), 1BOQ, 1BRQ, 1BSZ, 1BVB, 2BB, 2BM, 2EL, 2GK, 2JZ, (2OM), 2PF, 2RD, 2SR, 2SZ, (2TF), 2TS, 2TU, 2WB, 2ABM, 2AHU, 2AJE, 2AQE, 2ARK, 2AXK, 2BCF, 2BJO, 3CN, 3EL, 3FB, 3FO, 3FP, (3HJ), 3GP, 3JZ, 3KG, 3OU, 3RL, 3PR, (3TA), 3UC, (3UD), 3UQ, (3XM), 3ZO, 3AB, 3AQH, 3ARM, 3AXK, 3BFU, 4BY, 4IE, 4ZD, 5BY, 5PY, 5CH, 8EO, 8JJ, 8LB, 8LQ, 8OE, 8OU, 8PL, 8RQ, 8UC, 8WO, 8XE, 8XF, 8YV, 8ZW, 8AFG, 8AJX, 8AMD, 8AOS, 8AGF, 8APB, 8AVR, 8AXC, 8AXO, 8AXK, 8AWP, (8AYN), 8BUM, 9OX, 9RC, 9ZJ, 9ACB, 9DCX.

C.W.: 1PT, 1QJ, 1QP, 1ZE, (1BES), 1BDI, 2PZ, 2VA, 2AHF, 2AJE, 2AKF, 2AWL, 2BEB, 2BRC, 3FM, (3HJ), 3ZY, 3ALN, 3AQR, 4FT, 4GL, 4ID, 4ZE, 5AN, 5FV, 8BK, 8GY, 8IB, 8JM, 8OS, 8VY, 8XV, 8AGZ, 8AM, 8AQF, 8AWP, 8AXM, 8BAE, 8BDK, 8BUM, 8CIA, 8CLD, 9LE, 9WC, 9AJA, 9ALS, 9BRL, 9BSG.

1CMK, Holyoke, Mass.

C.W.: 1AGI, 1ARY, 1AZW, 1BEP, 1BDC, 1BDI, 1CPZ, 1BUA, (1BFU), 1BWJ, (1II), 1XM, (1QP), 2AWL, 2AWF, (2AAB), (2BNZ), (2AQU), 2AFP, (2AYV), 2AJF, 2AYI, 2AGB, 2EL, 2BB fone, 2BBB, 2CCL, 2BTJ, (3ALU), (3CG), (3BIY), (3AJD), (3BLF), 3AQR, 3BG, 3AIG, 3HJ, 3ZO fone, 3BJ, 3ZAB, 3VW, 3EM, 3ASO, 3SQ, 3VS, 3IL, 3ALN, 3APQ, (4ID), 4DC, 4AZ, 4GL, 4DB, 4CO, 5FV, 5EK, 5ACF, 8AQV, 8ADG, 8BBK, 8ACX, 8TB, 8AOA, 8AGZ, 8AWP, 8XAE, 8CAZ, 8CFP, 8QM, 8BXH, 8AXK, 8LF, 8KS, 8AWM, 8RO, 8ARW, 8TB, 8NB, 9LQ, 9IO, 9KP, 9ALS, 9DW, 9WK.

1CIK, St. Paul's School, Concord, N. H.

C.W.: (1AET), 1ALV, 1ARY, (1AWB), 1AZW, 1BDI, 1BEA, 1BEP, (1BES), 1BIR, 1BJS, 1BOI, 1BOQ, 1BQE, 1BUA, 1CNF, 1IL, 1IN, (1OE), 1OT, 1PT, 1XM, 1ZE, (2AAB), 2ABM, 2AJA, (2AJF), 2AJW, 2ALD, 2ANZ, 2AMO, (2AQH), 2AWK, 2AWS, (2AYV), 2AZF, 2AZZ, 2BEB, 2BEF, 2BEH, 2BG, Can. (2BG), 2BND, 2BNZ, (2BRB), 2BTJ, 2FP, 2IPD, 2KP, 2KW, 2SQ, 2TS, 2VA, 2VH, (2XK), 3AAD, 3AAK, 3ADE, 3AFZ, 3AHU, 3AIC, (3ALN), (3AJD), 3APD, 3AQH, 3AQR, 3BAG, 3BD, 3BEC, (3BG), 3BHL, 3BLF, 3BZ, 3CC, 3CO, 3CAA, 3DY, 3FS, 3HJ, (3KM), 3KW, 3MO, 3NH, 3QY, 3QV, (3RW), (3SJ), 3XE, (3ZO), 3ZY, 4BY, 4GL, 4ID, 5FV, 5UU, 8AFG, 8AGZ, 8AHK, (8AIM), 8AGT, 8ALD, 8ANJ, (8AOA), 8AQF, 8AQV, 8AWP, 8AWW, 8AWZ, 8AXK, 8BAE, 8BFR, 8BFX, 8BK, 8BNJ, 8BNU, 8BNU, 8BRL, 8BT, 8BTO, 8BUM, 8BZY, 8CGT, (8HT), 8LB, 8LF, 8LG, (8NI), 8OS, 8OW, 8PX, 8QM, 8TB, 8UF, 8UK, 8VY, 8WR, 8ZG, 9AAV, 9AJA, 9AJH, 9AKD, 9BRL, 9DAX, 9DY, 9HY, 9KP, 9PS.

Spark: (1ADL), 1AEF, (1BNK), (1CZ), (1OE), 2ABM, 2AHU, 2BJO, 2CES, 2CHE, 2OM, 2PR, 2TS, 2QW, 3AIC, 3APD, 3ARN, 3DM, 3OM, 3OU, 3TA, (3UC), 3UQ, 8AFG, 8APB, 8AXX, 8LB, 8SP, 8BH.

1NY, Belmont, Mass.

C.W.: 1DH, 1FB, 1PD, 1PO, 1PT, 1RD, 1ZE, 1AJG, 1APP, 1ATW, 1AVR, 1AYD, 1BDI, 1BDS, 1BES, 1BKQ, 1BKR, 1BWJ, 1BYG, 1CGG, 1CLZ, 1COC, 1COD, 1CRA, 1CRW, 1CSM, 2AAB, 2AFP, 2AJF, 2AWL, 2AQV, 2AYV, 2BGM, 2BJO, 2BNZ, 2BRC, 2BTJ, 2CCD, 2CGH, 2FF, 2FD, 2FP, 2LO, 2SQ, 2WT, 2PZ, 3CM, 3CZ, 3EM, 3FS, 3RW, 3UC,

3XM, 3ZO, 3ZY, 3AAG, 3ADX, 3ALN, 3AQR, 3BER, 3BFU, 3BLF, 3BNU, 4BY, 4GL, 4ZE, 5AW, 5FV, 5UU, 8OS, 8QM, 8VY, 8XV, 8PX, 8ZG, 8ZZ, 8AHS, 8AIM, 8AIO, 8AGZ, 8AQF, 8ARI, 8AUO, 8AVO, 8AWP, 8AWY, 8BBK, 8BDO, 8BDU, 8BRL, 8BUM, 8BXH, 8BZJ, 8CLD, 9AJA, 9AKR, 9AZE, 9BRL, 9IO, 9KP.

1BGI, Bangor, Me.

C.W.: 1AC, 1AK, 1CP, 1CY, 1DF, 1FB, 1II, 1LP, 1PT, 1QN, 1QP, 1QR, 1RD, 1RV, 1TS, 1UN, 1WV, 1XF, 1XK, 1XM, 1XX, 1YB, 1YK, 1YN, 1ZE, 1AFP, 1AFU, 1AIG, 1AJP, 1AMQ, 1ANQ, 1ARY, 1AVR, 1AWL, 1AXI, 1AYI, 1AYR, 1AZW, 1BAS, 1BDC, 1BDI, 1BEA, 1BEC, 1BEA, 1BEP, 1BES, 1BIF, 1BIR, 1BIS, 1BKE, 1BKQ, 1BLA, 1BLE, 1BMV, 1BQE, 1BQI, 1BRP, 1BSD, 1BUA, 1BWJ, 1CAK, 1CGS, 1CIV, 1CLI, 1CLN, 1CLZ, 1CNF, 1CJH, 1CUH, 1DEA, 1XAD, 2BA, 2BB, 2BG, 2CC, 2CS, 2DH, 2DK, 2EH, 2FD, 2FP, 2HI, 2KL, 2KU, 2NN, 2NZ, 2OM, 2RB, 2RM, 2RP, 2UD, 2VA, 2VH, 2WP, 2XQ, 2AAB, 2AAX, 2AGB, 2AJF, 2AJR, 2AJW, 2ALR, 2ANQ, 2AVU, 2AWF, 2AWK, 2AWL, 2AYV, 2BAK, 2BAS, 2BAY, 2BBB, 2BCF, 2BEA, 2BEB, 2BFZ, 2BGI, 2BGM, 2BIS, 2BNZ, 2BRB, 2BRC, 2BYW, 2CDA, 3AS, 3BF, 3BG, 3BS, 3BZ, 3CA, 3CC, 3CG, 3DH, 3DM, 3FS, 3GM, 3HX, 3IY, 3KM, 3LH, 3LR, 3MO, 3RF, 3RW, 3SQ, 3VW, 3WF, 3YR, 3ZC, 3ZO, 3ZV, 3ZY, 3ADT, 3AHK, 3AIS, 3AIB, 3AJD, 3AQH, 3AQR, 3ASV, 3BEC, 3BHL, 3BIJ, 3BLF, 4BY, 4DC, 4GL, 5AN, 5FV, 5UU, 8AW, 8BK, 8BS, 8BZ, 8DR, 8GQ, 8HJ, 8IQ, 8IV, 8JL, 8JQ, 8JS, 8KS, 8NI, 8OW, 8PU, 8QB, 8QM, 8SP, 8UJ, 8UK, 8VJ, 8XA, 8XV, 8ZG, 8ZV, 8ZZ, 8ABO, 8AGC, 8AGO, 8AGZ, 8AHR, 8ALY, 8AMK, 8AMQ, 8APH, 8APT, 8APW, 8AQF, 8AQO, 8AQV, 8ASG, 8AWP, 8AWY, 8AXC, 8AXO, 8AYZ, 8BBR, 8BDB, 8BFX, 8BGX, 8BIX, 8BNJ, 8BNS, 8BNY, 8BUM, 8BUZ, 8BXA, 8BXH, 8BXS, 8BZY, 8CAZ, 8CFP, 8CMZ, 9AL, 9DV, 9HR, 9HW, 9IO, 9AAV, 9ARK, 9AKD, 9BLO, 9DWJ, Can. 2BG.

Spark: 1AW, 1BH, 1CM, 1DZ, 1FV, 1GM, 1GQ, 1HK, 1OJ, 1OT, 1RV, 1TS, 1YB, 1YD, 1AEV, 1AFZ, 1AHL, 1AMD, 1APO, 1ARM, 1ARY, 1AZK, 1BCF, 1BDT, 1BIR, 1BIS, 1BOQ, 1BVB, 1CAK, 1CHJ, 1CIK, 1XAH, 2BK, 2BM, 2BY, 2DN, 2EL, 2FP, 2OM, 2XK, 2XQ, 2BJO, 3LC, 3OU, 3XM, 3ZA, 3ZV, 8AY, 8EA, 8JQ, 8MZ, 8SP, 8XE, 8ZY, 8ACF, 8AXO, 8BER, 8BEP, 9HR, 9KKG, Can. 3BP.

1BKQ, Worcester, Mass.

C.W.: (1FD), 1FF, 1LZ, 1MX, 1NE, (1ON), (1PT), 1RD, (1XM), 1ZE, 1AGI, (1ARY), 1AVI, 1AVR, 1AWB, 1AZW, 1BAL, 1BDI, 1BEA, (1BKR), (1BLE), 1BQE, 1BQK, 1BQL, 1BRQ, (1BSD), 1BUA, (1BWJ), 1BYG, 1CAC, 1CEC, 1CDZ, (1CGS), 1CIK, (1CLI), 1CMK, 1CNI, 1COA, (1COD), 2BB, 2BT, 2CG, 2DA, 2DN, 2ER, 2FP, 2KP, 2LD, 2NZ, 2PZ, 2RM, (2SQ), 2TF, 2TU, 2VA, (2VH), 2WI, 2AAB, 2AAG, 2AFP, 2AJF, 2AJW, 2AKO, 2AKV, 2ALR, 2AWF, 2AWL, 2AYV, 2AYZ, 2BAK, (2BEB), (2BCF), 2BEE, (2BEH), 2BEJ, 2BML, (2BNC), (2BNZ), 2BSC, 2BTJ, 2CBG, 2CCD, 3AW, (3BA), 3BG, 3BZ, 3CA, 3CM, 3EM, (3FM), (3FO), (3FR), 3FS, 3HF, 3HJ, (3IZ), 3JH, 3LR, 3RW, 3SH, (3UQ), 3WJ, 3XM, (3ZO), (3ZY), 3ZZ, 3AAD, (3AAE), 3ABT, 3ADT, 3ADX, 3AFB, 3AJP, (3ALN), (3ALU), 3AMG, 3ANO, 3ANX, 3APQ, 3AQH, (3AQR), 3ARN, 3BAG, 3BAR, 3BEC, 3BFU, 3BIY, 3BLF, 3BNU, 3XAA, 4BY, 4CO, 4DC, 4DY, 4FT, 4GC, 4GL, 4HW, 5DA, 5FV, 5UU, 5ZA, 8AV, 8BB, 8BK, 8BT, 8DR, 8HJ, 8JJ, (8JL), 8JU, 8KS, 8LB, 8MP, (8NB), 8NI, (8PX), 8QB, 8QM, 8QY, 8RM, 8RO, 8SE, 8SP, 8TB, 8TN, (8UK), 8VL, 8VY, 8WE, 8WK, 8WY, (8XV), 8ZG, 8ZZ, 8AAY, 8ACF, 8ADG, 8AGO, 8AGZ, 8AIG, 8AIM, 8AIO, (8AJV), 8ALB, (8AMK), 8AOA, 8AOO, 8AOT, 8APN, 8APT, 8AQN, (8AQV), 8ARD, 8AWH, 8AWM, (8AWP), (8AXC), 8AXK, 8AXM, 8AXO, 8AXY, 8AYS, 8AYT, 8AYY, 8BAE, 8BBK, 8BBW, 8BDO, 8BDU, 8BIL, (8BNJ), 8BRC, (8BRL), 8BUM, 8BUQ, 8BXA, 8BXH, 8CAZ, 8CFP, 8CLD, 8ZAC, 9DV, 9FM, 9HW, 9IO, 9JI, 9KP, 9UH, 9WU, 9XI, 9AAV, 9ACY, 9AHK, 9AIV, 9AJA, 9AJH, 9AKR, (9ALS), 9ARK, 9AYH, 9BRL, 9DTJ, 9ZIF, 9ZAF, (NOF).

Sparks: 1ADL, 1AKG, 1ARY, (1ASF), (1CHJ), 2CT, 3DN, 2ER, 2FP, 2JO, 2AQI, 2BJO, 3BG.

3FP, 2HJ, 8OU, (3TA), 3UD, 3ARM, 8AB, 8BO, 8PT, 8UC, 8WO, 8WU, 8XE, 8ABY, 8AGK, 8AIB, 8AIM, 8AKQ, 8APB, 8AWF, 8AWP, 8BDY, 8BSS, (8BXX), 9BP, 9AAW, 9DCX. Can. 3BP, 3EI, 3KG.

2AQU, Newark, N. J.

Spark: 1ADC, 1ADL, 1AHL, 1AKC, 1AKG, 1ARY, 1ASF, 1AW, 1AZK, 1BDT, 1BOQ, 1BQA, 1BRQ, 1BVH, 1BYG, 1OE, 1RV, 1WQ, 1ZE, 2AHU, 2DA, 2GK, 2XQ, 3AHK, 3AIC, 3AJD, 3ALN, 3AUW, 3BCQ, 3GX, 3HG, 3HJ, 3OU, 3QN, 3UC, 3XM, 4CP, 4CX, 4EA, 4GN, 5PY, 5XA, 5ABM, 5ACF, 5AFG, 5AHH, 5AJT, 5ALO, 5AMZ, 5ANO, 5APB, 5ARD, 5AUY, 5AWU, 5AXY, 5AYC, 5AYN, 5BAZ, 5BBO, 5BEP, 5BHV, 5BRL, 5BUN, 5EO, 5LB, 5NO, 5QC, 5SP, 5TT, 5UC, 5WD, 5WO, 5XE, 5YAE, 5YH, 5YN, 5YV, 5ZAA, 5ZAC, 5AAU, 5AGR, 5APH, 5APS, 5BP, 5DCX, 5DF, 5DIW, 5DLX, 5DWP, 5DZI, 5PB, 5UH, 5YAE, 5YB, 5YQ. Can. 3GN.

C.W.: 1AFV, 1AGI, 1AIP, 1AMQ, 1ARY, 1AVR, 1BDI, 1BEA, 1BKQ, (1BQ), 1BUA, 1BWJ, 1BYG, 1CAK, 1CGS, 1COD, 1MX, 1QN, 1QP, 1TS, (1XX), 1ZE, 2AAB, 2AWF, 2EH, 3AAD, 3AAG, 3AAN, 3AAY, 3ADT, 3ADX, 3AJD, (3ALE), 3ALN, 3ANJ, 3AQR, 3ARV, (3ASO), 3BEC, 3BG, 3BHL, 3BIJ, 3BLF, 3BZ, 3CM, 3FS, 3HG, 3HJ, 3LC, 3NH, 3RM, 3SM, 3XAA, 3ZO, 3ZY, 4BK, 4BQ, 4CO, 4FT, 4GL, 4ID, 4IL, 4YA, 4ZE, 5NZ, 5UU, 5ZA, 5JD, 5PT, 5AB, 5ABV, 5ACB, 5ADG, 5AGO, 5AGZ, 5AHZ, 5AIG, 5AIM, 5AJV, 5AMK, 5AOG, 5APT, 5AQP, 5ARD, 5ARL, 5AVD, 5AWF, 5AWP, 5AWY, 5BBK, 5BBD, 5BET, 5DEX, 5BFX, 5BK, 5BLT, 5BO, 5BOX, 5BRL, 5BUM, 5BUJ, 5BVK, 5BKH, 5CAB, 5CGX, 5CW, 5EH, 5LX, 5NL, 5OC, 5PX, 5UK, 5VJ, 5VV, 5WA, 5WA, 5WR, 5XV, 5XX, 5ZAE, 5AAS, 5AAY, 5ACE, 5AJH, 5AMU, 5AS, 5AXF, 5BED, 5BRL, 5BSG, 5DTJ, 5DV, 5DYN, 5DYT, 5IO, 5KP, 5YJ, 5ZL.

2AVE, Jamaica, L. I.

C.W.: 1FF, 1NE, 1AGI, 1AOL, 1AZW, 1BDI, 1BBS, 1BQE, 2DN, 2FF, (2GA), 2JJ, (2MM), 2RB, 2RM, (2RY), (2SQ), 2UJ, 2VA, 2XJ, 2AQT, 2AEQ, 2AJR, 2AMO, 2ANZ, 2AQU, 2AUU, 2AYV, 2AZZ, (2BCF), 2BEB, 2BEH, 2BFZ, 2BIV, 2BJQ, 2BKE, 2BLP, (2MW), (2BNC), 2BNL, (2BQW), (2BTW), (2BUO), (2BWA), (2BWV), 2BYW, 2BZV, 2CAF, 2CAH, 2CCD, 2CDK, (2CDW), (2CEC), (2CKQ), 2CIE, 2BG, 2CG, 2CM, 2FS, 2VW, 2YM, 2ZO, 2ZY, 3AAD, 3AAG, 3AFB, 3ALN, 3APZ, 3AQR, 3BAG, 3BLF, 3BLU, 3XAA, 3ZAB, 4AZ, 4CO, 4EH, 4EW, 4FT, 4GL, 4ZE, 5NZ, 5UU, 5ZA, 5BK, 5BO, 5BU, 5LB, 5LF, 5LW, 5NB, 5SP, 5UK, 5VJ, 5VY, 5XV, 5ZA, 5ZG, 5ZY, 5ABV, 5AGZ, 5AIM, 5AIO, 5AOG, 5AQF, 5AQV, 5AVD, 5AWL, 5AYT, 5AWP, 5BBK, 5BRL, 5BUM, 5BVK, 5XAD, 5JR, 5KP, 5AAV, 5AJA, 5AJH, 5AXF, 5BLO, 5BRK, 5YAM. Can. 3CZ.

Spk.: 1LZ, 1AGX, 1BQL, 1CHJ, 3AC, 3GE, 3GX, 3HJ, 3UD, 3AJD, 3ARM, 3ASH, 3AUW, 3BJT, 4EA, 4ET, 5HK, 5PY, 5EW, 5IH, 5IN, 5JJ, 5JL, 5LB, 5OD, 5SP, 5UC, 5WE, 5XE, 5WO, 5YH, 5ABM, 5ACF, 5AHH, 5AHS, 5ALO, 5AMZ, 5AOI, 5APE, 5AUY, 5AWY, 5AXC, 5AXY, 5AYN, 5BBO, 5BEN, 5BHU, 5BHV, 5BKC, 5BUM, 5BXC, 5BXX, 5AV, 5VL, 5ZJ, 5AAW, 5ACY, 5API, 5DIO, 5DKV. Can. 3GN, 3KG.

2ACW, Schenectady, N. Y.

Spark: 1ACO, 1ADL, 1AHL, 1ARY, 1AZK, 1BCF, 1BDI, 1BHR, 1BJE, (1BOQ), 1BQA, 1BRQ, 1BZ, 1CHJ, 1GM, 1LZ, 1OZ, 1RV, 1YB, 2AAF, 2AHM, 2AIM, 2ARK, 2BJO, 2BK, (2BM), 2BSC, 2DI, 2EL, 2NB, 2OM, 2PF, 2TS, 2WB, 2XK, 3AAB, 3AFS, 3AHK, 3AK, 3ARN, 3AUW, 3BFU, 3BGT, 3CC, 3FF, 3GX, 3HG, 3HJ, 3PB, 3PU, 3QW, 3UC, 3UD, (3UQ), 3ZX, 4EA, 4CX, 5AAA, 5AAB, 5ACF, 5ADQ, 5AFA, 5AFB, 5AFG, 5AGK, 5AHH, 5AHS, 5AJT, 5AKQ, 5ANW, 5AUY, 5AXC, 5AXO, 5AXQ, 5AYN, 5BEP, 5BDV, (5BFH), 5BHV, 5BMC, 5BOG, 5BVS, 5CEB, 5CF, 5CFX, 5CG, 5CH, 5EO, 5EW, 5FS, 5FT, 5IN, 5LB, 5MZ, 5NI, 5OP, 5PL, 5QC, 5QE, 5SG, 5SP, 5UR, 5VQ, 5WD, 5WO, 5XE, 5YM, 5ZP, 5AAP, 5AAW, 5ACB, 5ACL, 5AOE, 5APB, 5AV, 5AVP, 5CA, 5DFK, 5DFX, 5DKV, 5HR, 5JN, 5RC, 5UU, 5YAC, 5YAE, 5YB, 5YQ. Can. 2CI, 3BA, 3BP, 3EH,

3EI, 3EO, (3FO), 3GE, 3GN, 3JL, 3KG.

C.W.: 1AJS, 1BEA, 1BGF, 1BKQ, (1BUA), 1BYK, 1CGO, 1CMD, 1CNF, 1PT, 1UJ, 1XX, 1XY, 2AAB, 2AJF, 2AJR, 2ANZ, 2BAY, 2BEA, 2BGL, 2BNZ, 2BRC, 2VA, 3ADT, 3ADX, 3AHH, 3AQR, 3BEC, 3BG, 3CG, 3FS, 3OQ, 3TJ, 3ZO, 3ZY, 4EW, 4GL, 4LP, 5BM, 5FV, 5UF, 5AVO, 5AWP, 5AWY, 5AWZ, 5BDO, 5CA, 5DR, 5KK, 5ZX, 5ZZ, 9AJA, 9ALS, 9ARK, 9DKH, 9DV, 9PS, 9MU, 9ZY.

2BII, East Orange, N. J.

Spark: 1ADC, 1ADL, 1AIL, 1AKQ, 1AMD, 1AMQ, 1APO, 1ARY, 1AYQ, 1BDT, 1BGF, 1BHO, 1BJE, 1BOQ, 1BQL, 1BRQ, 1BSZ, 1BTL, 1BVB, 1BVH, 1CK, 1CP, 1CZ, 1GM, 1HK, 1IN, 1LZ, 1MA, 1OJ, 1ON, 1RV, 1SN, 1SO, 1UL, 1WQ, 2DA, 2GK, 2PV, 2SZ, 3AJD, 3ARN, 3ARY, 3BHM, 3CG, 3GM, 3GX, 3JL, 3NB, 3TA, 3XM, 4AU, 4BG, 4DH, 4EA, 5DA, 5XU, 5ABM, 5ACD, 5ACF, 5AFA, 5AFG, 5AIO, 5AKO, 5AKQ, 5ALO, 5ANW, 5AOT, 5APE, 5ARD, 5AUV, 5AVO, 5AWP, 5AWU, 5AWY, 5AXC, 5AXO, 5AXQ, 5AXY, 5AY, 5AYN, 5BBO, 5BCO, 5BDY, 5BFM, 5BFV, 5BLO, 5BRL, 5BX, 5BXC, 5BXX, 5BZC, 5CP, 5CQ, 5DX, 5DY, 5EA, 5HR, 5IH, 5IN, 5JJ, 5JP, 5KJ, 5KY, 5LH, 5MT, 5SF, 5SP, 5UC, 5UP, 5VQ, 5WD, 5WE, 5XE, 5YU, 5YV, 5ZAY, 5ACB, 5ACV, 5AGR, 5AIU, 5AJH, 5AR, 5AYH, 5AZE, 5BP, 5BXP, 5DBQ, 5DCX, 5DIW, 5DK, 5DKH, 5DWP, 5DXM, 5OX, 5RC, 5UH, 5UM, 5UU, 5ZJ, 5ZN. Can. 3BP, 3GE.

C.W.: 1AGW, 1AQZ, 1ARY, 1AVI, 1AVR, 1AWB, 1AZW, 1BAL, 1BDI, 1BDG, 1BEA, 1BJH, 1BKQ, 1BQE, 1BUA, 1BWJ, 1BYG, 1CGO, 1CGS, 1CIK, 1CJH, 1COA, 1ES, 1FF, 1II, 1IV, 1PT, 1QE, 1QN, 1UJ, 1XM, 1XX, 1ZE, 2BY, 3AAG, 3AAN, 3AQC, 3ADX, 3AFB, 3AHK, 3AIG, 3AJD, 3ALL, 3ALN, 3ANQ, 3AQR, 3ASO, 3BEC, 3BEK, 3BFQ, 3BHL, 3BHM, 3BIJ, 3BLF, 3CG, 3CO, 3DH, 3FR, 3FS, 3HG, 3IZ, 3KM, 3NH, 3OU, 3RW, 3UH, 3ZAB, 3ZY, 4AZ, 4BY, 4CO, 4DK, 4EN, 4FF, 4GL, 5FT, 5FV, 5UU, 5ZA, 5ZAD, 5ALE, 5ZA, 5ZB, 5AJV, 5AKS, 5ALB, 5AMB, 5AMD, 5AML, 5AMM, 5ACF, 5ADG, 5AGP, 5AGZ, 5AIG, 5AIM, 5AIO, 5AMZ, 5AOG, 5AOG, 5ARI, 5ARK, 5ASG, 5ASK, 5AVD, 5AWP, 5AWZ, 5AXK, 5AXO, 5AXQ, 5AYT, 5AZP, 5BBD, 5BBK, 5BDB, 5BDO, 5BET, 5BFX, 5BK, 5BLD, 5BO, 5BOX, 5BRL, 5BTP, 5BUM, 5BUQ, 5CAZ, 5CFK, 5CGM, 5GS, 5GV, 5HJ, 5IV, 5JL, 5LB, 5LW, 5LX, 5MB, 5ME, 5NB, 5NV, 5OH, 5OS, 5SJ, 5SP, 5UJ, 5UK, 5VJ, 5VY, 5WB, 5WL, 5WM, 5WO, 5WR, 5XK, 5XV, 5ZAE, 5AAS, 5AAU, 5AAV, 5AAY, 5AIG, 5AJA, 5AJH, 5AKD, 5AKR, 5ALS, 5AYS, 5BED, 5BRL, 5BSG, 5KP, 5SJ, 5ZAF, 5ZL. Can. 2BG, 3BP, 3GN, 3KE, 3KG.

2BND, Oceanport, New Jersey

1ADL, 1AEV, 1AGI, 1AOL, 1ARY, 1AZJ, 1BCV, 1BDQ, 1BFX, 1BIL, 1BKA, 1BKQ, 1BOQ, 1BPZ, 1BQE, 1BWI, 1BYX, 1CAK, 1CAL, 1CDR, 1CL, 1DWJ, 1DF, 1GM, (1IV), 1OE, 1OG, 1PM, 1RU, 1TJ, 1UN, 1UQ, 1ZE, 2ADL, (2AVU), 3AA, 3ADT, 3AHK, 3AIC, 3ANJ, 3AWK, 3BEC, 3BHL, 3BIY, (3BZ), 3CC, 3DH, 3FD, 3HG, 3HE, 3ZAB, 3CAN, 3BP and 3FO, 4BY, 4CE, 5EA, 5EL, 4GL, 5ACF, 5AFD, 5AFV, 5AGZ, 5AHR, 5AJT, 5AMK, 5AMQ, 5AOF, 5AQZ, (5AQF), 5AWP, 5AXO, 5AYN, 5AYS, 5AYV, 5AZH, 5BDO, 5BEP, 5BFX, 5BNY, 5BOX, 5AP, 5BK, 5BO, 5BP, 5DE, 5DR, 5DY, 5EO, 5H, 5IF, 5IQ, 5IV, 5JL, 5JQ, 5JS, 5OE, 5OL, 5QY, 5SP, 5RU, 5TT, 5WC, 5WE, 5WS, 5XE, 5XH, 5XS, 5XU, 5YH, 5YN, 5ZR, 5ZV, 5ZZ, 5AAY, 5AIV, 5AKR, 5AMB, 5DWP, 5EI, 5LQ, 5LR, 5WU, 5YQ, 5ZJ, 5ZN.

Spark: 1BOQ, 2KB, 2NB, 2OM, 3AAM, 3AC, 3AIC, 3AN, 3AJD, 3KJ, 3GZ, 3HG, 3IA, 3OU, 3QW, 3RA, 3SF, 3UC, 3VS, 3WF, 3YH, 4EA, 4GN, 5DA, 5PY, 5XA, 5AFD, 5AFG, 5AJT, 5ARD, 5ATU, 5AZC, 5BAZ, 5BEF, 5BEG, 5BEP, 5BHV, 5BXA, 5BRD, 5EH, 5OD, 5QE, 5SP, 5RQ, 5UC, 5UD, 5AAJ, 5AEK, 5AGR, 5AIR, 5AOE, 5ASJ, 5BP, 5CP, 5DSD, 5DWP, 5EP, 5FS, 5GX, 5UH, 5VL, 5WK.

C.W.: 1AYL, 1BGF, 1CGO, 1CLL, 1PT, 1TS, 1UN, 2AAB, 2AWA, 2AFP, 2BEH, 2BYW, 2IB, 2KP, 2OF, 3AAY, 3AHK, 3AJE, 3AJD, 3ALN, 3ANY, 3APT, 3AQR, 3BA, 3BAG, 3BG, 3BJA, 3BKS, 3BLF, 3BS, 3BZ, (3FQ), 3FS, 3GN, 3HAE, 3IB, 3KM, 3MZ, 3RF, 3RM, (3SQ), 3VS,

3WF, 3XAA, 3XT, 3YH, 3ZM, 3ZN, 3ZO, 3ZY, 4BQ, 4DC, 4DS, 4EW, 4GX, 4XD, 5FV, 5KU, 5UU, 5AAI, 5AGF, 5AGH, 5AIM, 5ALB, 5ALT, 5ANB, 5APT, 5ARP, 5ASV, 5ATV, 5AUZ, 5AWZ, 5AYZ, 5AZL, 5BAC, 5BDO, 5BDU, 5BFX, 5BHY, 5BO, 5BT, 5BUG, 5BYE, 5CAZ, 5CBR, 5CGX, 5CRG, 5GV, 5HJ, 5IQ, 5JS, 5PX, 5VJ, 5YM, 5ZX, 5AAS, 5AAV, 5AIV, 5AJP, 5AKD, 5AKR, 5BBF, 5BRL, 5DBU, 5DDW, 5EL, 5IO, 5KP, 5PI, 5PO, 5NOF.

3AQW, Trenton, N. J.

Spark: 1AED, 1AEV, 1ADL, 1ADR, 1AHL, 1AMD, 1APO, 1ARY, 1AZK, 1AW, 1BDT, 1BHR, 1BOQ, 1BSZ, 1CH, 1CHJ, 1CK, 1COK, 1DY, 1GM, 1HO, 1IA, 1H, 1LZ, 1RV, 1VQ, 1WQ, 1YB, 1YD, 2ARK, 2ARY, 2AWS, 2AZY, 2BB, 2BFX, 2BK, 2C, 2BJP, 2BY, 2CT, 2DR, 2EL, 2FT, 2NB, 2OM, 2QR, 2RV, 2GK, 2TS, 2TU, 2XQ, 2AC, 2ACE, 2ACM, 2AHK, 2AIA, 2AIG, 2AJB, 2AJD, 2AK, 2AF, 2AQR, 2AOR, 2AOV, 2ARM, 2ASP, 2ASY, 2ARN, 2ATZ, 2AUW, 2BFA, 2BF, 2CC, 2DR, 2EH, 2FB, 2GE, 2GN, 2HJ, 2HG, 2HX, 2EO, 2IT, 2KT, 2LK, 2MN, 2NB, 2OU, 2PB, 2QR, 2QW, 2TA, 2UD, 2VW, 2XC, 2XJ, 2XM, 2YP, 2YV, 2ZA, 2ZO, 2ZY, 2ZQ, 2ZS, 2XAE, 4BL, 4BQ, 4BX, 4CG, 4CX, 4DH, 4EA, 4ED, 4ET, 4FR, 4GN, 4YA, 4YB, 5DA, 5FO, 5FV, 5PY, 5XA, 5XB, 5XU, 5ZA, 5ZAB, 5ZAF, 5AG, 5AK, 5ACF, 5ADR, 5AFA, 5AFD, 5AFG, 5AGL, 5AHS, 5AHY, 5AHH, 5AIT, 5AJT, 5AKQ, 5ALO, 5AMZ, 5AOH, 5AOT, 5APB, 5AUE, 5AUV, 5AVZ, 5AVT, 5AWP, 5AXC, 5AXO, 5AXY, 5AXI, 5AYX, 5BAC, 5BBO, 5BBU, 5BEP, 5BFH, 5BFM, 5BHV, 5BN, 5BRL, 5BCO, 5BNU, 5BVS, 5CF, 5CH, 5CHV, 5DY, 5EA, 5EF, 5EO, 5EW, 5IH, 5KG, 5LW, 5MZ, 5QC, 5QQ, 5RQ, 5SP, 5TH, 5TT, 5TY, 5UC, 5VQ, 5XE, 5YN, 5AYN, 5YAA, 5ZAC, 5ZAE, 5ACY, 5AEG, 5AFD, 5AIE, 5AOE, 5ASJ, 5AWX, 5AZE, 5BP, 5CP, 5DBE, 5DCX, 5DFX, 5DHz, 5DKV, 5DQ, 5DSO, 5DWP, 5DXM, 5DY, 5DYU, 5EE, 5FS, 5HR, 5MC, 5ME, 5TT, 5UH, 5US, 5UU, 5YB, 5YC, 5YM, 5YQ, 5ZJ, 5AN, 5BP, 5CG, 5FO, 5GE, 5JL, 5KG, 5LI.

C.W.: 1ADL, 1AFV, 1AIP, 1AOL, 1ARY, 1AWB, 1AVR, 1AVA, 1AYL, 1BCF, 1BCG, 1BDC, 1BDI, 1BGF, 1BH, 1BHJ, 1BQE, 1BQK, 1BKJ, 1BTL, 1BUA, 1BWJ, 1BSD, 1BSS, 1CAK, 1CIV, 1CLB, 1CLI, 1CNF, 1COD, 1ES, 1FF, 1MA, 1NE, 1PT, 1QN, 1TS, 1UN, 1XJ, 1XM, 1ZE, 2AAB, 2AAX, 2ACH, 2ADV, 2AID, 2AJP, 2AJW, 2AKO, 2AFP, 2AQU, 2AWF, 2AWL, 2AYV, 2AYI, 2AYR, 2ANZ, 2AZZ, 2BAD, 2BAK, 2BAY, 2BEA, 2BEB, 2BFZ, 2BGM, 2BLP, 2BML, 2BNZ, 2BQK, 2BUA, 2BVH, 2CBT, 2CCD, 2CCP, 2CIC, 2FD, 2FF, 2FS, 2FZ, 2KP, 2LE, 2NZ, 2OF, 2NK, 2PZ, 2QR, 2TB, 2XHI, 2XH, 2XL, 2WP, 2AAD, 2AAE, 2AAG, 2AAN, 2AAY, 2ACC, 2ACQ, 2ADT, 2ADX, 2AEQ, 2AEV, 2AFU, 2AJB, 2AJD, 2AKU, 2ALE, 2ALN, 2ANJ, 2ANO, 2ANU, 2APA, 2APQ, 2AQF, 2AQH, 2AQL, 2AQR, 2AWI, 2AXY, 2BAG, 2BEC, 2BFQ, 2BHL, 2BIY, 2BLF, 2CA, 2CAA, 2BZ, 2CC, 2DH, 2FM, 2FR, 2FS, 2HG, 2HJ, 2HX, 2IH, 2IW, 2JJ, 2KD, 2KM, 2LZ, 2MZ, 2NO, 2NH, 2NN, 2OT, 2PB, 2QV, 2RM, 2RW, 2SH, 2SM, 2TA, 2VS, 2VW, 2XL, 2XY, 2YP, 2ZN, 2ZO, 2XAA, 2XHD, 2ZAB, 2BE, 2BF, 2BI, 2BQ, 2BY, 2CE, 2CL, 2DC, 2EL, 2EU, 2EW, 2FO, 2GL, 2GU, 2ID, 2IH, 2LE, 2XC, 2YK, 2CV, 2DA, 2FV, 2NZ, 2SU, 2ZAD, 2BW, 2ALE, 2AAI, 2ADG, 2AGO, 2AGZ, 2AIO, 2AHR, 2AJV, 2ALB, 2ANR, 2AOO, 2AMM, 2APW, 2AQF, 2AQV, 2AQZ, 2AWM, 2AWP, 2AWY, 2AWZ, 2BEX, 2BFX, 2AYZ, 2BDO, 2BK, 2BT, 2BQM, 2BNU, 2BUQ, 2BRM, 2BRC, 2BRL, 2BXA, 2BXH, 2BYE, 2CF, 2CGX, 2DR, 2GV, 2HJ, 2JM, 2JS, 2JU, 2LJ, 2LX, 2NI, 2OC, 2PX, 2RO, 2RQ, 2OS, 2SP, 2TB, 2TH, 2UD, 2UK, 2VY, 2WO, 2WY, 2WA, 2WB, 2XE, 2Z, 2ZAC, 2ZAE, 2AAY, 2AJA, 2AKR, 2ALS, 2AMB, 2ARK, 2BLO, 2DNY, 2DXN, 2DY, 2HW, 2II, 2IO, 2KP, 2PN, 2PS, 2WD, 2WC, 2WK, 2ZY, Can.: 2BP, 2AL, Fone: 1XAD, 1XE, 2BB, 2LO, 2XAL, 2XJ, 2AYI, 2AYR, 2AYZ, 2BAK, 2CAP, 2HJ, 2XU, 2YQ, 2ZO, 2AWI, 2BRW, 2AWP, 2AXC, 2SV, 2XM, 2BNO.

3ZAB, Roanoke, Va.

C.W.: 1AGI, 2BGA, 2RQ, 2SQ, 2KW, 2AU, 2WS, 2BNZ, 3APD, 3ZY, (3APA), 3CA, (3BIY), (3RF), 3APB, 3BZ, (3SQ), 3ADE, 3BG, 3BLF, 3CM, 3CT, 3FS, 3AAD, 3AW, 3BEC, 4BQ, 4ID, 4EN, 4EW, 5UU, 5FV, 5DA, 5NZ, 5AWP, 5BNW, 5AWM, 5BAL, 5JM, 5RAX, 5LW, 5ANR, 5AHR, (5AIM), 5AOA, 5AQF, 5XV, (5BEX), 5AWZ, (5AGZ),

5BK, 5AXK, 5AYZ, 5AGO, 5AJ, 5AKD, 5IO, 5JL, 5BHI, 5BRK, 5BLO, 5BRL, 5ANS, 5KP, 5AAY, 5AAS, 5AOU, Spark: 2ABB, 3APD, 3BG, (3AAL), 5AU, 5BR, 5ARY, 5DN, 5YMC, 5BV, 5AKQ, 5WT, 5XE, 5ADQ, 5ZN, 5GC, 5XM, 5DF, 5RC, 5BIW.

3ZY, Washington, D. C.

C.W.: 1FF, 1QN, 1UN, 1UJ, 1PT, 1ZE, 1AFV, (1AGI), 1AIP, 1AJS, (1ARY), 1AZW, (1BDI), 1BEA, 1RES, 1BTL, 1BUA, 1CAK, 1CIK, 1BWJ, 2DN, 2EH, 2FP, 2KP, 2LO, 2PZ, 2RB, 2SQ, 2VA, 2XA, 2XK, 2ZS, 2AAH, 2AFP, 2AQU, 2AYI, 2AKO, 2AJP, 2AYV, 2AJA, (2ANZ), 2BML, 2BEH, 2BLP, 2BGM, 2BEA, 2BFZ, 2BCF, 2BAK, 2BYS, 2BEB, 3AS, 3BA, (3BZ), (3CG), (3CA), 3CC, 3CM, (3FM), 3FS, 3HJ, (3HG), 3IZ, (3RF), 3SQ, 3TJ, (3ZO), 3AWF, 3AJD, 3AQR, (3AAG), 3AAY, 3AQH, 3AAD, (3AHK), 3BQY, 3BIO, 3BJ, 3BLF, 3BHL, 4AZ, 4BQ, 4BY, 4BK, 4DC, 4EB, (4ET), (4GL), 4GX, 4ID, 4YA, (4ZE), 5FV, 5LA, (5UU), 6ZZ, (5BK), 5BA, 5BO, (5CW), 5DR, 5GS, 5GV, 5HJ, (5JL), 5JU, (5LX), 5LW, 5NI, 5OS, 5OC, 5OW, 5PX, 5QB, 5SF, 5UK, 5VY, 5VJ, 5WR, 5XK, 5XV, 5ZG, 5ZZ, 5AIO, (5AMM), (5AQV), 5AWP, 5AQF, 5AXK, 5AIG, 5AWY, 5AJW, 5AMD, (5AWZ), 5AXC, 5ASB, 5AGZ, 5AQO, 5AIM, (5ACF), 5AVH, 5AWM, 5ARW, 5AYZ, (5BUM), 5BQM, 5BCA, 5BXH, 5BRC, 5BOX, 5BFX, 5BNU, 5BDO, 5BUX, 5BNJ, 5CAZ, 5CLD, 5CGT, 5CHO, 5YAA, 5QM, 5AS, 5AG, 5DV, 5IO, 5LE, 5NX, 5HW, 5SJ, 5WO, 5XM, (5ZL), 5ZY, 5AWM, (5AAV), 5AJP, (5AJH), (5AJA), 5ALS, 5AKD, 5AAY, 5BRL, 5DYN, 5XQ, 5AN, 5DF, 5KKA phone, 5WB phone, 5ZO, (5WUB). Sparks: 2OM, 3AHK, 4EA, 5EW, 5XE, 5AYN, 5AJT, 5AFG.

3FM, Philadelphia, Pa.

Spark: 1AKG, 1ARY, 1BHR, 1CHJ, 2BK, 2FP, 2OM, 3AHK, 3CAA, 3BP, Can. 5EB, 5IN, 5RQ, 5UC, 5WO, (5XE), 5ACF, 5ARD, 5AXC, 5AXY, 5BBO, 5BBU, 5BF, 5CA, 5UU, 5AAW, 5AGR, 5DKV.

C.W.: 1PT, 1ZE, (1AGI), 1AMS, 1AVR, 1AWB, 1AWH, 1AZW, 1BDI, 1BEA, (1BES), (1BKQ), (1BWJ), 1CAK, 1CGG, 1CGS, 1CIK, 2FP, 2NZ, (2PZ), 2XJ, 2AAG, 2ADL, 2AJP, 2AWL, (2AYV), 2BNZ, 2BYS, 2CBG, 2CCD, (2BA), 3CG, (3EM), 3KM, 3LR, 3SJ, (3TJ), (3XM), (3ZO), (3ZY), 3AAG, 3AHK, (3ALN), (3BFU), 3BLF, 3BMJ, 4AZ, 4CO, 4CL, 4FT, 4GL, 4ZE, 5FV, 5UU, 5BK, 5BO, 5CW, 5GS, 5GV, (5IV), (5JL), 5JS, 5KH, (5LW), (5LX), 5NI, 5OC, 5OS, 5PX, 5QM, (5RQ), 5UJ, (5UK), (5VJ), (5VY), 5YV, 5ACF, 5ADR, (5AGZ), 5AIM, 5AIO, 5AJV, 5ALB, 5AMD, 5AMK, (5AMM), 5APN, 5AQF, 5AQV, 5ASO, 5ATU, (5AVH), 5AWF, 5AWP, 5AXC, 5AXK, 5BBK, 5BCA, 5BDB, 5BDO, 5BET, 5BFX, 5BOX, (5BRL), 5BTO, 5BTP, 5BUM, 5BUX, 5BXH, 5CAZ, 5CGT, 5CGY, (5CLD), 5AR, 5AS, 5FM, 5HW, (5IO), 5JL, (5KP), 5XJ, 5ZL, (5AAV), 5AJA, 5AJH, 5AJP, 5ALS, 5AXF, (5AYH), 5BKZ, 5BLO, 5BPQ, 5BSG.

4KC, Asheville, N. C.

1BCG, 1AW, 1AAW, 2QR, 2ALY, 3AM, 3EL, 4EL, 4BY, 4ZO, 4AF, 4AQ, 4LT, 4GH, 4DS, 4GL, 4AS, 4GM, 5AR, 5SA, 5LF, 5AW, 5CA, 5FQ, 6AR, 6EL, 6FA, 6BK, 6NR, 6YN, 6MR, 6AE, 7DA, 7AS, 7PQ, 7ES, 7GA, 7HE, 7GE, 7ER, 8CX, 8BCL, 8BUN, 8BK, 8HA, 8ALY, 8AM, 8FE, 8CA, 9XM, 9PL, 9AR, 9ZN, 9PL, 9ZL, 9CR, 9CS.

4GE, Savannah, Ga.

Spark: 5AOV, 4AS, 4BQ, 4BC, 4CP, 4CX, 4DZ, 4EH, 4GU, 5AA, 5DA, 5FO, 5GI, 5HK, 5TG, 5XA, 5YL, 5ZAB, 5ABV, 5AEK, 5AFG, 5AYN, 5BEP, 5CP, 5DJ, 5EB, 5UC, 5XE, 5YM, 5ACB, 5AEK, 5AOJ, 5AQM, 5DGH, 5DFX, 5DLX, 5DQ, 5DHZ, 5MC, 5PE, 5YC.

C.W.: 1TS, 1UN, 2AAB, 2AAG, 2AGB, 2ZG, 2ZL, 3BHL, 3BJ, 3BLF, 3BZ, 3LR, 3RF, 4BK, 4BQ, 4CO, 4AZ, 4EM, 4EU, 4EW, 4GU, 4HW, 4HO, 4ID, 4XD, 4ZE, 5AAM, 5DA, 5EK, 5FV, 5JB, 5KU, 5LA, 5NZ, 5UU, 5ABV, 5AOA, 5AKR, 5AWZ, 5BFX, 5BOX, 5CAZ, 5CQU, 5GV, 5JL, 5UJ, 5XK, 5BLO, 5BRL, 5DTW, 5DWP, 5DYN, 5IO, 5NX.

4YA, Atlanta, Ga.

2AAB, 2ALR, 2CBG, 2AKO, 2PFF, 2BEG, 2OM, 2ZO, 3FS, (3ZY), 3BLF, 3CM, (3XM), 3BIY, 3ZC, 3BZ, 4EW, 4AG, 4BY, 4EU, (4AS), (4EB), (4BK), (4BQ, 4ZE, 4DZ, 4EA, 4GU, 5AA, 5HK, 5XA), 5ZL, (5NZ), 5ZAB, 5ZX, 5EK, (5XB), 5ZAP, 5ZZ, 5KP, 5PY, 5GI, 5EY, 5RA, 5LA, 5AJ, (5UU), 5YM, 5YL (5FV), 5KU, 5FJ, 7VY, (8AIM), 8YU, 8AWP, 8VY, 8BOX, 8AJV, 8UC, 8BRK, 8BFX, (8AYM), 8AVH, 8AQF, 8AFG, 8AMD, 8BGU, 8AGZ, 8ACF, 8DJ, 8BEP, 8AUE, 8BEX, 8ZY, 8FS, 8ASB, 9JU, 8WD, 8BK, 8XK, 8XF, 8ZW, 8SP, 8VX, 8AFC, 8DHG, 8YAE, 8XE, 9HK, 9YC, 9BVL, 9YE, 9BJV, 9IO, (9DUN), (9BED), (9AS), 9AFW, 9AQ, 9DEJ, 9ZAC, 9EA, 9ACK, 9ARI, (9AJH), 9WU, 9EL (9AJA), 9XI, 9LF, 9DTS, 9BBE, 9DKM, 9PS, 9PL, 9YMM, 9VQ, 9ASP, 9CAK, 9APA, 9AKR, 9JL, 9BO, 9DQ, 9TV, 9ALO, 9AUA, 9DIW, (9AIQ), 9EM, 9XM, 9FT, 9ZW, 9XJ, 9DCF, 9YA, 9ARK, 9KS, 9YAK, 9AMQ, 9BAW, 9DSD, 9WT, 9ZJ.

4GM, Atlanta, Ga.

Spark: 2EH, 2FP, 2OM, 3AFD, 3AFU, 3AOV, 3EQ, 3UC, 3YV, 4AS, 4BE, 4BQ, 4CX, 4DH, 4DK, 4EG, 4EZ, (4FD), 4GH, (4GN), 4GU, 5AA, 5BY, 5DA, 5EA, 5ER, 5EW, 5FO, 5GI, 5HK, 5IM, 5JD, 5JO, 5KU, 5NK, 5PE, 5PY, 5SM, 5SO, 5TG, 5XA, 5YG, 5ZZ, 5ZAB, 8AY, 8AGV, 8AJZ, 8ANO, 8ANW, 8ARD, 8AXC, 8AYB, 8AYN, 8AZP, 8BAZ, 8BFX, 8BHV, 8CP, 8SP, 8UC, 8VH, 8VQ, 8VY, 9AOJ, 9ARK, 9AZE, 9BLO, 9DCX, 9DFX, 9DHZ, 9YV, 9AU, 9AAW, 9ACB, 9AEG, 9AGR, 9AMS, (9DKV), 9DQK, 9DMJ, 9DNI, 9DXE, 9DYU, 9DZY, 9KO, 9LF, 9MC, (9OX), 9PG, 9RC, (9RY), 9UH, 9UW, 9VQ, 9VZ, 9ZB.

C.W.: 2FP, 3AIN, 3BIJ, 4BQ, 4BY, 4FD, 4ZE, 5FV, 5KU, 5XA, 8AK, 8AWP, 9AJA, 9ALS, 9CFP, 9GY, 9IO, 9NX, 9YM.

5IF, Amarillo, Texas

5AA, (5AE), (5BI), (5BM), (5BY), (5EK), 5ER, (5FA), (5FO), 5HI, (5HK), (5HZ), (5IB), (5IC), (5IE), (5IS), (5JD), 5JL, 5JL, 5JR, 5JX, (5KP), 5LB, 5LO, 5LX, (5MJ), 5MM, 5MP, (5MY), (5NC), 5NH, (5NK), 5NR, (5NS), (5OF), 5OH, 5PD, (5PE), 5PG, 5PX, (5QA), (5QI), 5QO, (5QS), 5QY, (5RA), 5SM, 5TG, 5XA, (5XB), (5XJ), (5XT), 5XU, 5YI, 5YN, 5YQ, (5ZA), 5ZD, 5ZJ, (5ZL), 5ZN, 5ZS, (5ZU), 5ZAG, (5ZAK), 5ZAB, 5ZAC, 5ZAE, (5ZAF), 5ZAG, (5ZAK), 4BQ, (6TV), (6ZZ), (6AAH), 7MO, 7ZU, 7ZV, (9PS), 9RT, (9RY), (9TI), (9TL), (9UG), 9UU, (9HT), 9JN, 9KO, 9LF, 9MS, (9NR), (9OA), 9YU, (9AU), 9EL, 9ET, 9GN, (9HI), 9HM, 9VE, (9WI), (9WU), 9XJ, 9YA, 9YM, 9YO, 9ZJ, 9ZN, 9ZY, 9YAE, 9YAJ, 9YAK, (9ZAC), 9ZAF, 9AAS, (9ABV), 9ACB, 9ACN, (9AEG), 9AEY, 9AFC, 9AFL, 9AFW, 9AHZ, 9AIF, 9AIG, 9AJH, 9AJT, 9AKR, 9ALS, (9AMA), 9AME, (9AMD), (9AMS), (9ANF), (9ANO), 9AOE, (9AQE), 9AQM, 9AQR, 9ARG, 9ARI, 9ARJ, 9ASJ, 9ASL, 9ASO, 9ATN, 9ATV, (9AUL), (9AUO), 9AVC, 9AVE, 9AVG, (9AWX), (9AYV), (9AYW), 9BAP, 9BBF, 9BOW, 9DEH, 9DEY, 9DFL, 9DJB, 9DJX, 9DKQ, 9DKV, (9DPB), 9DPE, 9DPH, (9DSD), (9DUG), 9DVA, 9DWP, 9DXX, (9DZE), 9DZR.

5AQ, Miami, Okla.

Spark: 5AA, (5BY), 5EK, 5ES, 5EW, 5FO, (5HJ), 5HZ, 5IP, 5IQ, 5IR, 5JD, 5KC, 5LA, 5LB, (5LO), (5NH), 5NK, 5QA, 5QK, 5TG, 5UH, (5WI), 5XA, 5XB, 5XU, 5XL, 5ZA, 5ZL, 5ZZ, 5ZAB, 5ZAK, 7ZO, 5ZU, 5ZG, 5MC, 8UC, 8VV, 8BC, 9BP, 9DW, 9EE, 9FK, 9HT, 9JN, 9KO, 9LW, 9MC, 9MS, 9PE, 9RC, 9UH, (9UU), 9WT, 9WU, 9WX, 9YM, 9YO, 9ZA, 9ZN, 9ZX, 9AAP, 9ABV, (9ADR), 9AEG, 9AEY, 9AFX, 9AGN, 9AGR, 9AIF, 9AKD, 9AKR, 9AMU, 9AOE, 9AOU, 9APS, (9APX), 9AQM, (9ATN), 9AUL, 9AVI, 9AVX, 9AWA, 9AYA, 9AYV, 9BEK, 9BJE, (9DKV), (9DNI), 9DNS, (9DPB), 9DQK, 9DSD, 9DUG, (9DXD), 9YAC, 9YAE, 9YAK.

C.W.: 1BCG, 2FP, 4FI, 4GL, 4II, 4YA, 4YG, 4KM, 5EK, 5FV, (5JB), 5LA, 5ZA, 5ZAK, 8AQ, 8BK, 8VY, 8XV, 8BOX, 9BS, 9FM, 9KM, 9NX, 9FS, 9WS, 9XI, 9AGR, 9AJA, 9AQR, 9AYS, 9BDV, 9BED, 9BLO, 9BSG, (9DHB), 9DTS, 9DUN, 9DUP, 9DYN, 9YAM, 9ZAF.

5LA, New Orleans, La.

C.W.: (3ZY), 3HG, 3AKR, 3AQR, 3BLF, 4AS, (4BK), 4BQ, 4BY, 4CO, 4EB, 4EW, 4EH, 4EL, 4FH, 4FT, (4GL), 4GU, (4II), 4ID, 4XD, 4XF, 4ZE, 5ER, (5FV), 5EK, 5IR, 5KP, (5MT), (5ZA), 5XJ, 5UU, (5NZ), 5ZX, 5KU, 5ZU, 5ZAK, 5BK, 5BO, 5CG, 5CW, 5GV, 5IV, 5SL, 5SP, 5VY, (5WY), 5XK, 5XV, 5ZL, 5ZV, 5ARW, (5AGZ), 5AGO, 5AWZ, 5AQH, 5AWA, 5AQF, 5BQJ, 5BOX, 5BFX, 5AIM, 5ABV, 5AKJ, 5AQE, 5BQJ, 5BOX, 5BFX, 5BVR, (5BEX), (5BXH), (5BZC), 5BRL, 9AT, 9BV, 9DY, 9EL, 9FM, 9HK, 9II, 9IZ, 9JL, 9JR, 9NX, 9PG, 9LY, 9SJ, 9WU, 9XI, 9ZL, 9ZW, 9AII, 9AUA, 9AAY, 9AWM, 9AJH, 9AAS, 9ALH, 9AMB, 9AYS, 9AKD, 9APH, 9AIE, 9AVN, 9AJA, 9AEQ, 9ALU, 9AMU, 9AIG, 9BBF, 9BED, 9BIG, 9BOW, 9BIK, 9BIB, 9SC, 9DIG, 9DKP, 9DKI, (9DZQ), 9DTM, 9DFL, 9DGF, 9DPE, 9DTW, 9DHB, 9YB.

5MB, Chattanooga, Tenn.

C.W.: 2BAY, 2LO, 2AWF, 3AEV, 3AQR, 3BIY, 3CA, 3HG, 3RF, 3ZY, 4AS, 4BD, 4BK, 4BY, 4EB, 4EH, 4ER, 4EL, 4CY, 4C, 4IL, 4YA, 5AN, 5BX, 5FV, 5FX, 5JD, 5JL, 5KU, 5LA, 5SU, 5WS, 5ZA, 5ZAB, 5ZW, 5ACS, 5ACV, 5AFG, 5AQV, 5AWP, 5AWZ, 5BDE, 5BRV, 5BLF, 5BK, 5BOX, 5BIQ, 5JU, 5WA, 5WL, 5YT, 5ZAC, 9AAS, 9AAV, 9AIK, 9AJH, 9AJP, 9AK, 9AKO, 9ARK, 9AUA, 9AVN, 9BED, 9BIZ, 9BLD, 9DPE, 9FM, 9PG, 9SJ, 9ZB.

Spark: 2AHU, 2BK, 3AOV, 3DV, 3HG, 4AC, 4AH, 4AU, 4BI, 4CP, 4DH, 4EA, 4EV, 4GH, 4GL, 4GN, 4GU, 4HS, 4JS, 4NE, 4BQ, 5AAG, 5DA, 5ER, 5EW, 5FO, 5GU, 5HK, 5IF, 5JD, 5PY, 5XA, 5XB, 5XU, 5XY, 5YL, 5ZAP, 5ZL, 5AFD, 5AIZ, 5AP, 5AWY, 5BEP, 5BHO, 5BRL, 5CGZ, 5CFQ, 8JJ, 8SP, 8UC, 8US, 8WD, 8XE, 8YN, 9ABC, 9ACL, 9AEG, 9AGR, 9AIF, 9AIR, 9AIV, 9ATN, 9AWQ, 9AW, 9DCX, 9DL, 9DS, 9DXM, 9FN, 9GX, 9JN, 9LF, 9MC, 9QR, 9UH, 9VA, 9VE, 9VH.

5ZZ, New Orleans, La.

1ARY, 1BCG, 2EL, 2FP, 2NZ, 2AJF, 2ZL, 2AWL, 3AL, 3BL, 3BP, 3BZ, 3CA, 3MO, 3NZ, 3AHK, 3AJD, 3BHL, 3BLF, 4AE, 4AN, 4AS, 4AT, 4AU, 4BI, 4BK, (4BQ), 4BY, (4CG), 4CN, 4CP, (4DH), (4EH), 5EL (4EL), 4FB, 4FD, 4FF, 4FT, (4GL), 4GN, (4GU), 4HW, (4YA), (4ZC), 4ZE, (5AE), 5BM, 5BI, 5DA, 5EK, 5ER, 5EW, (5FA), (5FO), 5FV, 5GI, 5GV, (5HK), 5HZ, 5IC, 5ID, 5IF, 5IR, 5IS, (5JD), 5JI, 5KP, 5KV, 5KU, 5LB, 5LO, 5LX, 5MA, 5MF, 5MY, 5MT, (5NB), 5NC, 5NF, (5NH), (5NK), 5NQ, 5NS, 5NZ, 5OF, 5OH, 5PD, 5PE, (5QA), 5QQ, 5QS, 5QZ, 5QY, 5QX, 5RA, 5TG, 5UC, 5UE, 5UJ, 5UU, (5XA), 5XB, 5XI, 5XJ, 5XK, 5XR, 5XT, 5XU, 5YB, (5YI), 5YN, 5ZA, 5ZC, 5ZD, 5ZL, (5ZL), 5ZO, 5ZR, 5ZS, 5ZT, (5ZU), 5ZW, 5ZX, 5AAM, 5ZAA, 5ZAF, 5ZAG, 5ZAK, 5ZAM, 5ZAN, 5BK, 5BO, 5BU, 5CP, 5CW, 5DE, 5DR, 5EA, 5FI, 5FQ, 5HA, 5HJ, 5IL, 5IQ, 5JL, 5JM, 5JP, 5JQ, 5LQ, 5LX, 5NZ, (5OI), 5ON, 5RB, (5SP), 5TN, (5UC), 5UJ, 5UK, 5VJ, 5VR, 5VY, 5XE, 5XK, 5XV, 5YM, 5YN, 5YR, 5YT, 5ZG, 5ZN, 5ZR, 5ZW, 5ZY, 5APB, 5ACF, 5ACL, 5ADE, 5AFB, 5AFD, 5AFG, 5AFV, 5AFS, 5AGK, 5AJK, 5AJT, 5AKS, 5AMB, 5ANO, 5ARD, 5ARG, 5AUH, 5AQF, 5AQV, 5AWZ, 5AYN, 5BEN, 5BEP, 5BFF, 5BHV, 5BIB, 5BOS, 5BOX, 5BPL, 5BRL, 5BUM, 5BGK, 5ZAA, (5ZAC), 9AU, 9BP, 9DV, 9DW, 9EL, 9ET, (9FS), 9FU, 9FZ, (9GC), 9GN, 9GX, 9HD, 9HI, 9HJ, 9HM, 9HR, 9HS, 9HT, 9IO, 9IY, 9JN, 9JQ, 9KO, (9LF), 9LW, 9LO, 9MC, 9ME, 9MN, 9NH, 9QK, 9NR, 9NX, (9OA), 9OE, 9PD, 9PS, 9QE, 9QH, 9RV, 9RY, 9TL, 9TV, 9UV, 9UG, 9UH, 9UI, 9VG, 9VL, 9VV, 9WC, 9WI, 9WP, 9WU, 9XT, 9XJ, 9XM, 9YA, 9YB, 9YC, 9YM, 9YO, 9YQ, 9YT, 9YV, 9YAK, 9ZB, 9ZJ, 9ZAC, 9AAK, 9AAP, 9AAS, 9AAV, 9AAY, 9ACB, (9ACL), 9ACN, 9AEG, 9AEK, 9AEY, 9AFF, 9AFL, 9AFX, 9AGH, (9AIF), 9AIO, 9AIP, 9AIR, 9AIS, 9AJE, 9ALS, 9AMA, 9AMB, 9AMK, 9AMQ, 9AMS, 9AMT, 9AMV, 9ANF, 9ANO, 9AOJ, 9APB, 9API, 9AQA, 9AQE, 9AOJ, (9AQM), 9AQK, 9ARK, 9ARZ, 9ASJ, 9ASL, 9ATI, (9ATN), 9AVN, 9AVP, 9AWN, 9AWX, 9AWU, (9AWZ), 9AXU, 9AYW, (9AZA), 9AZE, 9BBF, 9BCX, 9BDS, 9BED, 9BLO, 9DAZ, 9DCX, 9DKQ, 9DKV, 9DHB, 9DMJ, 9DQL, (9DQK), (9DUG), 9DRA, (9DSD), 9DTN, 9DWP, 9DWJ, 9DXM, 9DYU, 9DZJ, 9DZK, 9DZY.

Spark: 1AHL, 1AX, 1ON, 1XX, 2AJE, 2BEJ, 2BFX, 2BB, 2BJ, 2FP, 2GK, 2OM, 2TF, 2XQ, 3AAB, 3AHK, 3ATZ, 3ARW, 3BEX, 3CG, 3CM, 3EL, 3FO, 3OG, 3UD, 3WJ, 3XM, 3XQ, 4AG,

4CX, 4CJ, 5HK, 5PY, 5XA, 5XB, 5XP, 5XU, 5YA, 5YE, 5YW, 5ZL, 5ZW, 5ZZ, 8AJX, 8AOK, 8AAK, 8AIZ, 8AYN, 8APB, 8APG, 8AQF, 8AYE, 8AWT, 8AKQ, 8AXK, 8ALM, 8BIW, 8BVS, 8BFM, 8BSV, 8TXC, 8BBA, 8CLP, 8CCU, 8CGZ, 8CA, 8CP, 8DJ, 8JF, 8EJ, 8EX, 8FA, 8FE, 8FZ, 8GW, 8IP, 8JJ, 8JR, 8KE, 8KG, 8KL, 8LB, 8LC, 8OE, 8OT, 8QQ, 8SP, 8TX, 8VG, 8VW, 8XE, 8XP, 8XR, 8YAE, 8YE, 8YM, 8YN, 8WZ, 8ZAE, 8ZA, 8ZF, 8ZY, 9AAP, 9AOU, 9AEK, 9ACB, 9ALO, 9ARR, 9ARG, 9AXU, 9AZA, 9AC, 9BEE, 9BP, 9CA, 9CB, 9DFX, 9DDQ, 9DCX, 9DFO, 9DSO, 9DAR, 9DIW, 9DH, 9DY, 9FM, 9FS, 9GK, 9GY, 9HR, 9IO, 9JL, 9JU, 9KE, 9KI, 9MC, 9OK, 9OX, 9QJ, 9RC, 9RY, 9SJ, 9TV, 9UU, 9WK, 9WN, 9WS, 9WT, 9WU, 9XE, 9XL, 9XM, 9XK, 9YA, 9YB, 9YC, 9YQ, 9YAE, 9YE, 9YM, 9YO, 9XAG, 9ZL, 9ZJ.

C.W.: 1AAB, 1AGI, 1ABL, 1ARY, 1AW, 1BCG, 1BDI, 1BDJ, 1BEL, 1BEM, 1BES, 1BRQ, 1BVB, 1BKQ, 1BEL, 1BG, 1CMK, 1DF, 1ON, 1RD, 1TS, 1XA, 1XJ, 2AFP, 2AYU, 2AJF, 2AAX, 2ANV, 2BEB, 2BFZ, 2BNQ, 2BEJ, 2CCD, 2JW, 2NE, 2SQ, 2VA, 2ZK, 2ZN, 3AKO, 3AAD, 3AAK, 3AAT, 3ANY, 3AQR, 3ARM, 3BER, 3BEX, 3BGV, 3BIY, 3BTJ, 3BLF, 3BEC, 3BFU, 3BAV, 3BSL, 3BRQ, 3BRX, 3CBQ, 3CM, 3FS, 3IQ, 3KG, 3KO, 3RW, 3ZE, 3ZO, 3ZY, 3ZZ, 4BK, 4BY, 4EW, 4FT, 4GK, 4GL, 4KK, 4IL, 4GE, 4YA, 4YB, 4ZE, 5AAM, 5AN, 5CX, 5DQ, 5EK, 5FV, 5IX, 5JB, 5KP, 5LA, 5NQ, 5NZ, 5PY, 5UU, 5YE, 5ZE, 6ALE, 7AA, 7DM, 8AAG, 8AQG, 8AOU, 8APD, 8AUS, 8ANJ, 8AJT, 8AJD, 8AVD, 8AMG, 8ARD, 8ASB, 8AJV, 8ALB, 8AIM, 8ALV, 8ARV, 8AQZ, 8ASB, 8AXD, 8ABV, 8AYQ, 8ARW, 8ARQ, 8AGZ, 8AHE, 8AMF, 8APV, 8AQF, 9ASO, 9AWF, 9AZV, 9ASZ, 9AZE, 9AIO, 9AIX, 9AWN, 9AJF, 9AUS, 9ARS, 9AWY, 9ADG, 9AUX, 9ATU, 9AJB, 9AWZ, 9AGZ, 9AYT, 9ALE, 9AWF, 9BEX, 9BVO, 9BDO, 9BYV, 9BOX, 9BFX, 9BNO, 9BUM, 9BUS, 9BDI, 9BEF, 9BKR, 9BPI, 9BUQ, 9BLT, 9BBW, 9BLW, 9BK, 9BO, 9BR, 9BU, 9BK, 9CEM, 9CGX, 9CAH, 9CGZ, 9CLD, 9CEN, 9CA, 9GR, 9GV, 9HD, 9JL, 9JM, 9JU, 9JW, 9NI, 9RM, 9SP, 9TX, 9VC, 9VO, 9VY, 9VB, 9WI, 9XK, 9XU, 9YAW, 9YM, 9ZAE, 9ZF, 9FG, 9ZV, 9ZK, 9ZZ, 9ASL, 9AFF, 9AXF, 9AJS, 9AKD, 9AJA, 9ALS, 9AJH, 9ANS, 9ARG, 9ATV, 9AFT, 9AYE, 9AJV, 9AYV, 9AMU, 9AAY, 9AS, 9AT, 9BJE, 9BFT, 9BWV, 9BBF, 9BDF, 9BRL, 9CP, 9DEJ, 9DDW, 9DTJ, 9DTS, 9DFA, 9DAM, 9DWN, 9DB, 9DJ, 9FS, 9HK, 9HW, 9IL, 9IO, 9JL, 9JN, 9JU, 9JR, 9KP, 9NX, 9OX, 9PS, 9QA, 9QE, 9RY, 9SJ, 9WV, 9XJ, 9XT, 9XM, 9YAM, 9YAJ, 9YB, 9YC, 9ZAC, 9ZA, 9ZY.

9AOG, Lawrence, Kansas

Spk.: 5AR, 5BM, (5BY), 5EH, 5EW, 5FA, 5FI, 5FO, 5HF, 5HK, 5HZ, 5IR, 5IS, 5JP, 5JR, 5KP, 5LB, 5LO, 5MF, 5NH, 5NS, 6OH, (5PG), 5PU, 5QI, 5RA, 5RW, 5TG, 5TU, 5WC, 5XA, 5XAB, 5XB, 5XJ, (5XU), (5YI), 5YL, 5ZA, 5ZAB, 5ZAG, 5ZC, 5ZL, 5ZW, 5ZZ, 7ZO, 7ZV, (8AMZ), 8ARS, 8ATU, (8AVT), 8BBU, 8BEF, 8CP, 8IN, 8JJ, 8MR, 8OH, (8QC), 8UR, 8VL, 8WO, 8ZN, (9ACL), (9AEY), (9AHZ), (9AIG), (9ALU), (9ANO), (9ANQ), (9AOJ), (9AQO), (9AR), (9ARG), (9BCF), (9BKK), (9BSA), (9CAK), (9DJB), (9ARZ), (9ASK), (9ASO), (9ATN), (9AYW), (9DGW), (9DJX), (9DLC), (9DNC), (9DSO), (9DSN), (9DTA), (9DTS), (9DVF), (9DXW), (9DZE), (9DZI), (9FU), (9HI), (9RY), (9YAK).
C.W.: 1XM, 2FP, 2QR, 3AJD, 3HG, 3BEC, 3NB, 4BK, 4BQ, 4BY, 4CO, 4EL, 5EK, 5FV, 5IR, 5KP, (5KV), 5MT, 5RF, 5SI, (5YI), 5ZA, 6AIF, 6VW, 6XAD, 8AGZ, 8AIO, 8AMA, 8AMD, (8AQH), (8AQV), 8AR, 8ARD, 8AWF, 8AXK, 8BEF, 8BFX, 8BOX, 8BRF, 8BRL, (8BUM), 8BVR, 8DR, (8IQ), 8IV, (8JL), 8NI, (8OH), 8SP, 8UJ, 8VJ, 8WA, 8XV, 8ZAE, 8ZL, (9AJA), (9AJH), (9AJP), (9AMB), (9AQR), (9ARG), (9ASD), (9AUA), (9AVN), (9AYS), (9AZP), (9BBF), (9BED), (9BIZ), (9BJV), (9DDW), (9DKX), (9DPL), (9DTA), (9DZQ), (9EX), (9FM), (9JL), (9XI), (9ZL).

9BMN, Sedalia, Missouri

Spark: 5AC, 5BY, 5CJ, 5EH, 5EW, 5FO, 5GI, 5HK, (5IR), (5JD), 5JF, 5KP, 5LB, 5MF, 5OF,

5PY, 5QA, 5QS, 5QQ, 5RA, 5SM, 5TG, 5TS, 5UC, 5UG, 5XB, 5XU, 5XI, 5XR, 5YG, 5ZA, 5ZAB, 5ZAG, 5ZL, 5ZJ, 5ACF, 5AFG, 5ANO, 5APG, 5ATU, 5AWP, 5AX, 5AXC, 5AXY, 5AYN, 5EA, 5EB, 5HD, 5IUY, 5JJ, 5LB, 5NZ, 5UC, 5UR, 5WO, 5XE, 5YN, 5YU, 5ZAC, (9AAG), 9AAW, 9AAP, 9AC, (9ACB), 9ACL, (9ACN), 9AEG, 9AEK, 9AFW, 9AGN, 9AGR, 9AIF, 9AIG, 9AIU, 9AIX, (9AJN), 9AJJ, 9AK, 9ALS, 9ALU, (9AMA), 9AMS, (9ANF), 9ANO, 9ANQ, (9AOJ), 9AP, 9APB, (9APN), 9APS, 9AQA, 9AQM, 9AR, 9ARG, 9ARN, (9ARZ), 9ASK, (9ASN), 9ATN, 9AU, 9AUL, 9AUA, (9AVK), (9AVC), (9AVZ), 9AV, 9AX, 9AYW, 9AZA, 9AZE, 9BCC, 9BEP, (9BSA), 9BTN, 9BTQ, 9BUZ, 9DAG, (9DAZ), 9DCX, 9DDV, 9DDZ, 9DEH, 9DFA, 9DFX, (9DGH), 9DHZ, 9DIW, (9DKQ), 9DKV, (9DLX), 9DMJ, 9DMM, 9DMP, (9DPB), 9DPH, 9DQ, 9DRO, 9DRX, 9DSO, 9DSM, 9DSO, 9DUU, 9DWP, 9DXM, 9DXT, 9DXV, (9DYO), 9DZE, (9DZI), 9DZY, 9CA, 9EE, (9FK), (9FS), 9HL, 9HR, 9HT, 9IY, 9JAA, 9JN, 9KI, 9KO, 9LF, 9LJ, 9LW, 9MC, 9MS, 9NQ, 9NR, (9OA), 9OX, 9PS, 9QJ, 9RC, 9RY, 9SC, 9TU, 9TV, 9UK, 9UU, 9UW, (9VB), (9WI), 9WT, 9WW, 9WY, 9XI, 9XM, 9YA, 9YAC, 9YAE, 9YAJ, (9YM), 9ZH, 9ZL, 9ZV.

C.W.: 2FP, 3AQR, 4BY, 5AN, 5FV, 5KU, 5NZ, 5UU, 5ZA, 5AOZ, 8AQV, 8AXK, 8AZE, 8BFX, 8BXA, 8HJ, 8JL, 8SP, 8XV, 9AAV, 9AJA, 9AJP, 9ALS, 9ARK, 9AS, 9ASD, 9ASF, 9AUA, 9BBF, 9BIX, 9BLO, 9BNO, 9BRL, 9DAX, (9DTA), 9DTM, 9DPZ, 9DYN, 9DZQ, 9FM, 9HW, 9IO, 9KP, 9LF, 9LQ, 9QY, (9SJ), 9XAB.

9IO, Newport, Ky.

(1AGI), (1AZW), (1BDI), 1BEA, 1BES, (1PT), 1TS, (1XM), 1ZE, 2AAB, (2AJW), (2AWF), 2AWL, (2AWS), 2AYV, (2BB), 2BAK, (2BFZ), (2BNZ), (2BRC), 2BNJ, (2FD), (2FP), 2VA, 2ZL, 2NQ, (3AAD), 3AAE, 3AHK, (3ALN), 3AQR, 3APA, (3BA), (3BG), (3BHL), 3BLF, (3BZ), 3CA, 3CC, 3CM, (3EM), (3FM), (3FS), (3HG), (3HJ), (3KM), (3QV), (3RF), (3SQ), 3ZO, 3ZY, (BK), (4BQ), 4BY, (4DS), 4EB, 4EL, (4EN), 4EU, (4EW), (4FT), (4GL), 4ID, 4ZE, 5DA, 5EK, (5FV), 5HK, (5JB), 5KU, 5NZ, 5XA, 5ZA, 5ZX, 6XAD, (8AGO), (8AGZ), (8AIG), 8ALB, 8APN, 8APT, (8AQF), 8AQR, (8ARD), 8ARW, 8ASB, (8AWP), (8AWY), (8AWZ), (8BK), 8BO, (8BOX), (8BRL), 8BUM, (8BXA), (8BXH), (8CFP), 8CI, (8CW), 8DR, (8EA), 8II, (8JL), (8JU, 8LF, 8MP, (8NI), 8OC, 8PX, (8SP), (8UJ), (8UK), 8VJ, (8VY), 8WA, (8WI), (8WR), (8WY), 8XV, 8ZG, (8ZIE), 8ZZ, 9AAP, (9AAS), (9AAV), (9AJA), 9AJH, (9AJP), 9AKD, 9AKR, (9ALS), (9AS), (9AT), (9AUA), 9AXF, (9BBF), 9BKZ, 9BLO, 9BRL, (9DCF), 9DDW, (9DTJ), (9DTW), 9DUN, (9DV), (9DYN), 9EL, (9IZ), 9JL, 9KP, 9NX, 9OO, 9PS, 9QE, 9SJ, 9US, (9UW), 9WU, 9XAG, 9XI, 9ZAC, 9ZAF, 9ZL.

9BLD, McLean, Ill.

Spark: 4BQ, 4CX, 4DH, 5AC, 5AIO, 5BK, 5CR, 5DA, 5EK, 5ER, 5EW, 5FO, 5HK, 5IC, 5IG, 5IK, 5JF, 5KP, 5LA, 5LB, 5LO, 5MF, 5NH, 5OF, 5PG, 5QA, 5SK, 5SM, 5TG, 5TU, 5UC, 5XA, 5XK, 5ZA, 5ZN, 5ACF, 5AFG, 5ARD, 5ARS, 5AYN, 5BAZ, 5BCO, 5LC, 5UK, 5XE, 5YE, 5ZAC, 5ZY, 9ABH, 9ACB, 9ACL, 9AEG, 9APF, 9AGR, 9AHZ, 9AIG, 9AJB, 9AMA, 9ANG, 9ANH, 9AOE, 9AOJ, 9AOS, 9AOW, 9AP, 9APB, 9AQM, 9AQW, 9ASL, 9ATL, 9AUL, 9AVL, 9AWV, 9AXV, 9AZA, 9AZE, 9AZF, 9BAW, 9BCU, 9BEH, 9BJ, 9BIT, 9BMN, 9BNT, 9BO, 9BP, 9BS, 9BSA, 9BKZ, 9CA, 9DAG, 9DBU, 9DDH, 9DEU, 9DEW, 9DFX, 9DGH, 9DHZ, 9DKV, 9DLX, 9DMP, 9DPZ, 9DQ, 9DSO, 9DTS, 9DUV, 9DUY, 9DY, 9DZE, 9DZQ, 9DZK, 9DZY, 9FM, 9FS, 9GL, 9HI, 9IB, 9IN, 9LF, 9MC, 9MS, 9OX, 9RC, 9RY, 9TG, 9TV, 9UA, 9YU, 9VW, 9WI, 9XI, 9XT, 9YA, 9YAM, 9YAN, 9YY, 9ZAC, 9ZS, 9ZX.

C.W.: 4BQ, 5FV, 5HR, 5KV, 5UU, 5ZX, 6ZZ, 8AGZ, 8AIG, 8ASM, 8BOX, 8CLD, 8AAO, 9AAU, 9AJA, 9AJH, 9AKR, 9ALS, 9AS, 9AWM, 9AX, 9AWM, 9AX, 9BEE, 9BBF, 9BED, 9BEG, 9BIZ, 9BLO, 9BNO, 9DBV, 9DCL, 9DCH, 9DHB, 9DKX, 9DWS, 9DYN, 9HK, 9KP.

A STORM RELAY ROUTE

(Continued from page 67)

Chicago. Work was started at once by 9XI, 9ZT and 9AJP, the latter two stations on C.W. At 10 a.m. communication was established with 9DR at Buffalo, Minn., and as that station has a very favorable location it was used as a central station the remainder of the day. Mr. Wallace at Buffalo raised 9MF at St. Cloud and 9QE at Fairmont (all C.W.) before noon. At noon St. Cloud was in touch with Brainard and with 9BAC to the north of there. Fairmont on the other hand had gotten in touch with New Ulm, Minn., and before the end of the afternoon had also established the network to 9YAE in Le Mars, Iowa. The entire system was checked every hour. Le Mars was in touch with Davenport and through him to Roodhouse, Ill., 9MC, at 4:00 p.m., when the re-establishment of the telephone line removed the necessity of longer maintaining the network just as Chicago traffic was about to be started.

Although there was a wire line through to Chicago it was not capable of handling any more than official communication service of the company and they could not touch any news service so the amateurs were again asked to help. The two sta-

tions 9XI and 9ZT with the wonderful "silent co-operation" of the rest of the Twin City amateurs set out to get into communication with Chicago. This was done at 11:30 and the press service was just about to file with the radio station in Chicago when once more the lines were restored. In the meantime the evening press from NAA had been copied and given the papers. This matter was gladly used and the amateurs were given over a column of space on the front page on the Minneapolis Tribune and other Twin City papers.

The real value of the entire affair is in the fact that such a communication network could be built up and maintained in daylight by amateurs without any previous arrangement. *That Citizen Radio can serve in an emergency is an undisputed fact* in the Twin Cities and thereabouts. Much credit is due to the stations establishing this network and especially to Mr. J. F. Carpenter of 9XI, managing the city of Minneapolis, for his early grasp of the situation, intelligent routing of messages, and his fortitude in sticking on the job forty hours without sleep.

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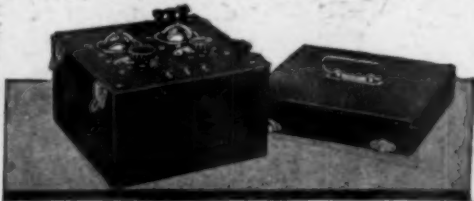


The Radiohome Receiver

The DT-800 Amplifier

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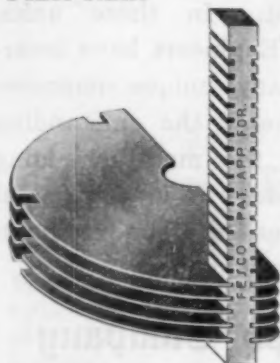
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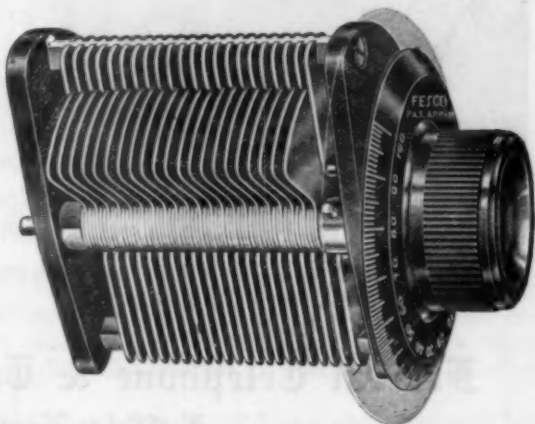
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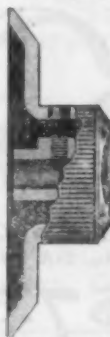
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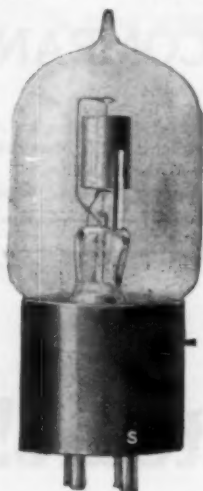
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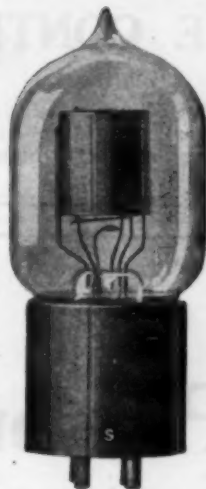


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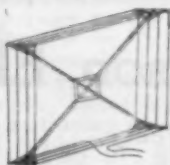
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Chart and tables giving proper number of turns to put on coil for any wave lengths covering 0 to 3600 meters 50c; 3600 to 24000, 50c. Stamps not accepted. C. A. DAVIS & CO., 2371 Champlain N. W., Washington, D.C.

MURDOCK

radio necessities



No. 56 Phones

MURDOCK REAL RADIO RECEIVERS have delivered complete satisfaction, on a "money-back" basis for 14 years. Those years of experience have so simplified and perfected our production that there are today no receivers quite so good at so low a price.

The latest Murdock achievement, the No. 56 Receiver, is a highly sensitive instrument which retains all the rugged strength of previous types. Important features are, the improved comfortable headband, the "Murdock-Moulded" ear pieces shaped to exclude outside noises and the moulding of all parts into one durable unit.

All models of Murdock receivers are sold with free trial offer and money-back guarantee. Use them in direct comparison to any other phones for 14 days.

Make any test you wish. Then at the end of the two weeks, if the Murdock Phones are not entirely satisfactory, return them and your money will be refunded!

We strongly urge you to go to your dealer, and convince yourself of the quality of Murdock receivers, by actual examination, before you buy. Prices \$5.00 to \$6.00.

Murdock Phones are the standard bearer for a complete line of "Made-by-Murdock" radio parts and instruments. This includes the famous Murdock condensers, sockets and detectors, and the new Murdock Rheostat.

Buy Murdock apparatus from your dealer.

WM. J. MURDOCK Co.



\$5.00

"IT SPEAKS FOR ITSELF" ARKAY LOUD SPEAKER RADIO HORN

Make your own Loud Speaker by simply inserting one of the 'phones from your head set.

The Arkay Radio Horn is so designed as to reproduce signals, speech and broadcasted music without distortion, giving a pure and natural tone.

The Arkay Horn is carefully constructed of brass throughout, finished in either black, hard rubber finish, or full polished nickel as desired.

Its construction is such that it will fit any of the popular makes of radio receivers. This is accomplished by means of an adapter concealed under the base, which is provided with an opening to permit the horn to set over the receiver cord. Construction of the adapter is sufficiently rigid to prevent vibration, thereby eliminating any overtones or distortion of signals, speech or music.

Arkay Horns work equally well on one or two stages of amplification.

If not obtainable at your dealers, we will forward one direct, upon receipt of purchase price, plus the postage to your station.

Shipping weight 4 pounds.

Price, Black enamel, without 'phone **\$5.00 each**
Polished nickel without 'phone **6.00 each**

Dealers write for our proposition. Immediate delivery.

DISTRIBUTED BY

Indianapolis, Ind.
Hatfield Electric Co.
Newark, New Jersey.
Economy Auto Supply
Co., Inc.
Radio Distributing Co.
Pittsburgh, Pa.
Ludwig Hommel & Co.
Robbins Electric Co.

New York City
Continental Radio &
Electric Corp.
Manhattan Electrical
Supply Co., Inc.
Ship Owners Radio
Service, Inc.
Toledo, Ohio
Marshall-Gerken Co.

MANUFACTURED BY

RILEY-KLOTZ MFG. CO., 21 Mulberry St., Newark, N. J.

WIRELESS DISTRIBUTORS

Handle
B. & P.
INSULATORS



No. 1

Aerial
Necessity
Insures
Safety
and
Perfect
Insulation



No. 2

Immediate Delivery

Write for Exclusive Territory
and Quotation

Banister & Pollard Co.

206-208 Market St.,

Newark, N. J.

HYGRADE SPECIALS Save You Money

7 Stranded Copper Aerial Wire	
100 Feet	.85
Radio Service V.T. Sockets	.80
Crosley V. T. Sockets	.55
22½ V. Cyclone Small B Battery	.90
22½ V. Cyclone Large B Battery	1.60
22½ V. Eveready B Battery	1.50
45V. Cyclone Large Variable B Battery	2.75
22½ V. Large Eveready Variable B. Battery	2.50
Binding Posts (rubber Cap) per doz.	.75
.0005 MF. Grid Condensers	.25
.002 MF. Phone Condensers	.25
Variable Grid Leaks ½ to 3 meg-ohms	.65
Electrode Ball Insulators 28c each, per doz.	3.00

Marko Storage Batteries

6 Volt 40 Amp.	10.00
6 Volt 60 Amp.	13.50
6 Volt 80 Amp.	17.00
6 Volt 100 Amp.	21.50

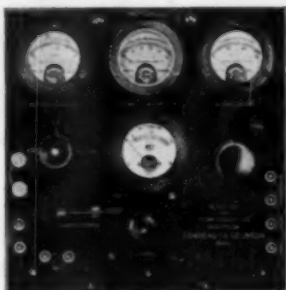
We do not charge for crating
Above batteries are fully charged when shipped. The above
prices are F. O. B. New York.

Hygrade Electrical Novelty Co.

41 West 125th Street.

New York.

Condensite



IF the molded insulation of your radio set is made of Condensite and the panel of Condensite-Celoron, you will have a combination that for appearance and lasting service will have no equal.

No other material possesses in such a high degree the properties essential to radio insulation.

We do not manufacture finished parts but upon request will gladly send the names of the leading radio concerns who make their instruments of Condensite.

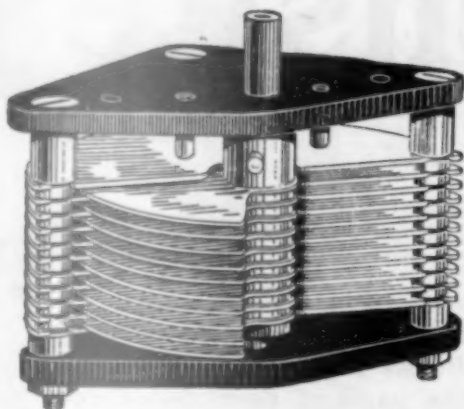
Condensite-Celoron is a waterproof fibre especially adaptable for panel work.

It can be obtained in sheets, rods and tubes of standard size; in two colors, brown or black, from the Diamond State Fibre Company, Bridgeport, Penna.

CONDENSITE COMPANY OF AMERICA

BLOOMFIELD NEW JERSEY

HECO



VARIABLE CONDENSERS

Made in 23 and 43 plate. Spacing of plates and casting of pillars and plates give uniform capacity at all times. Spring bearings assure even tension and good contact. Parts made and assembled under direct supervision of our radio engineers.

We can positively guarantee 24 hours shipments on all orders.

#100 23-plate .0005 MFD List \$4.00
#200 43-plate .001 MFD List \$4.50
Prices do not include knob, dial, or scale.

Special proposition open to jobbers and dealers.

HATFIELD ELECTRIC COMPANY
INDIANAPOLIS, IND.

QST de ANTHRACITE RADIO SHOP, P. O. Box 3, Scranton, Pa., successor to Shotton Radio Mfg. Co., of this city.

We wish to announce that we will carry at all times, a complete line of parts, as well complete sets representing the leading manufacturers.

Service - is our watchword.

A Trial will convince you.

Send 5c. for our catalog of Parts

ANTHRACITE RADIO SHOP, P. O. Box 3, Scranton, Penna.

VARIOMETERS AND VARIOCOUPERS



These instruments are wound with extra heavy wire to reduce the resistance, and have special long bearings with a spiral spring inserted to insure a perfect and self cleaning contact at all times. The taps on the Vario-Coupler are arranged in two groups. Furnished with round or square base. Variometer as illustrated ..\$6.00 Vario-Coupler as illustrated 6.00

Round or Square Base

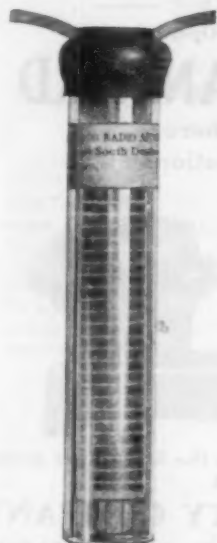
Get them at your dealer's.

SIMPLEX RADIO CO.

1013-15 Ridge Av., Phila. Pa.



"Chi-Rad" Apparatus



New Storage "B" Battery

A real storage "B" Battery for your Radio Set at a price every Amateur and Experimenter can afford to pay. Can be used on receiving apparatus as source of plate potential on both Detector and Amplifier tubes. Ideal as source of energy on small Radio Telephones or C.W. Transmitters.

Simple and easy to re-charge from your lamp socket and will last for years with ordinary use.

Price per cell \$0.50
Add PP on $\frac{1}{2}$ lb.
per cell.

SPECIFICATIONS:

Cut shows cell one half natural size.

Voltage per cell 2 volts.

Pasted Plates—ready formed for initial charge.

High Ampere Hour capacity—will operate one detector tube 1000 hours with one charge.

Shipped dry with simple directions for preparing the electrolyte.

Mahogany Tray for holding ten cells \$1.00 extra

Dealers:—Get our discounts on this new Battery—your customers will want them!

REMOVAL NOTICE

About April 1st we will move to 415 South Dearborn Street where we will open a High-Grade Ground Floor Salesroom. With greatly increased space we will carry every make of good Radio Apparatus and will endeavor to have

"The Finest Radio Retail Salesroom in Chicago."

CHICAGO RADIO APPARATUS CO., Inc.

415 South Dearborn Street,

Chicago, Ill.

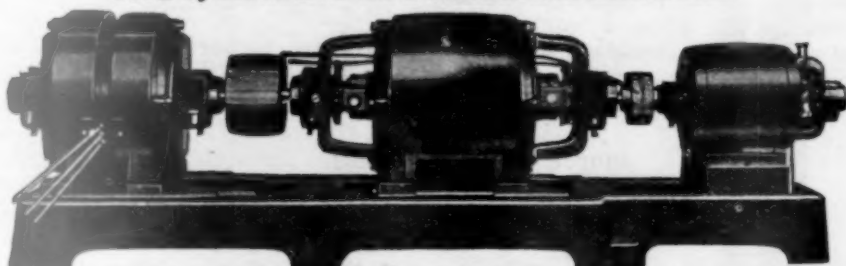
TRADE **ESCO** MARK

MEANS THE LAST WORD IN
MOTORS, DYNAMOTORS, GENERATORS, MOTOR GENERATORS
Designed and Developed by PIONEERS

In Perfecting High Voltage Apparatus for Wireless Operation

ESCO PRODUCTS ARE STANDARD

Sold by PRINCIPAL DEALERS Everywhere
Used by LEADING EDUCATIONAL Institutions



This Outfit Enabled 1BCG—GREENWICH, CONN., to be among the first to get across the Atlantic in the recent Amateur Contest

Ask for Bulletin 237
Listing over 200
Combinations.

ELECTRIC SPECIALTY COMPANY
215 South St., STAMFORD, CONN., U.S.A.



Amplify your signals with ACME Transformers

Acme Transformers in your vacuum tube amplifier equipment, magnify voice and music as well as code without distortion and without howling. They are priced as low as specialized quantity production permits, with due regard for quality. At all Radio dealers.

Acme Apparatus Co.

194 Massachusetts Ave.,
Cambridge, Mass.

*Transformer and Radio Engineers and
Manufacturers*

HERE

RADIO CITIZENS

Complete stocks carried for immediate shipment of the following apparatus:

Grebe Murdock
DeForest Adams-Morgan
Acme Radio Corporation
C. Brandes, Inc.
Federal Telephone & Telegraph Co.

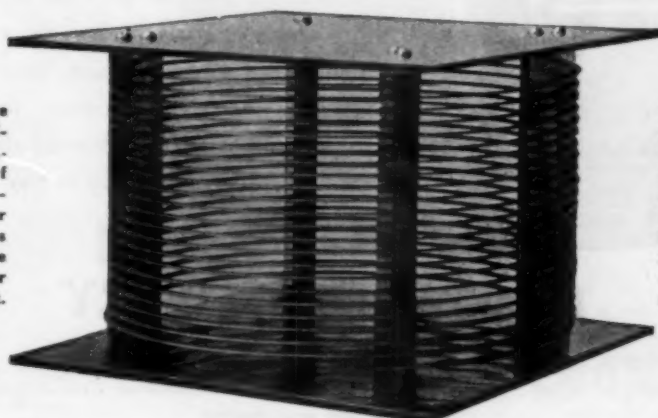
FREE BULLETINS PRICE LISTS

Get the new lowest prices on apparatus and supplies. Bulletins and price lists mailed FREE on your request. Send for them today.

Nash Electrical Service Co.
Marshall, Ill.

We can't make ALL of the radio apparatus — so we just make the BEST of it

The use of the WIMCO INDUCTANCE assures you of maximum results from your CW outfit. Its low resistance means greater antenna output.



Used everywhere where the best apparatus is desired. Order from your Dealer. Price 25 turn size \$10.00, Grid Coil \$2.00 extra.

WIMCO CW 100 INDUCTANCE

The following data on the resistance of the WIMCO C.W. INDUCTANCE was furnished by the Washington Radio Laboratories, Washington, D. C. It was measured for ten turns, this being the average number of turns in use on most amateur aerials at 200 meters wave length;

Wave length	H. F. Resistance
150	.71 ohms
200	.85 ohms
250	.95 ohms

(effective inductance 80.5 microhenries at 200 meters)

Full description of this inductance, and circuit diagram is contained in the WIMCO catalog, mailed anywhere on receipt of 15 cents in stamps.

ANNOUNCING THE "STANDARD" AUDIO FREQUENCY AMPLIFYING TRANSFORMER. We are distributors for the new Standard amplifying transformer designed for Cunningham and Radiotron tubes, 9 to 1 ratio, equal to any transformer on the market, and are in position to make immediate deliveries. Price \$5.00 fully mounted and thoroughly guaranteed. DEALERS—JOBBER'S WRITE.

REMLER APPARATUS—CUNNINGHAM TUBES—FROST REGENERATIVE RECEIVING SETS—CLAPP-EASTHAM AND FEDERAL PRODUCTS—HIPCO PLATE BATTERIES—WORKRITE VARIOMETERS AND COUPLERS—KLOSNER VERNIER RHEOSTATS—FADA APPARATUS—BRANDES AND BALDWIN HEADSETS

8ZV WIRELESS MANUFACTURING CO. 8ZV

CANTON, OHIO

JOBBER'S—MANUFACTURERS

Chelsea No. 50 Amplifying Transformer



Was designed for use with the present day models of vacuum tubes, and when so used produces remarkable amplification, with minimum noise. It is well adapted for table mounting or may be panel mounted in any position. Its high efficiency together with its neat appearance and compactness, makes it a predominating feature in any radio receiving equipment.

IMMEDIATE DELIVERY

Price as shown\$4.50
Unmounted3.75

Bulletins sent upon request

Purchase from your dealer. If he does not have it, send to us.

CHELSEA RADIO COMPANY

150 FIFTH STREET,

CHELSEA, MASS.

RAY-DI-CO PRICES DEMAND QUICK ACTION!

LET YOUR EYES TRAVEL OVER THESE SPECIALS, THEN ACT!

RAY-DI-CO Variometer Set \$13.50

Completely set up. Consists of two Variometers and one tapped variocoupler. Only the highest grade mahogany used in forms,—non-shrinking, non-cracking, limit stops on rotor. No grating sounds from sliding contacts.

\$10.00 Knocked down complete with hardware.

FORMICA PANELS

9x14x $\frac{1}{8}$	\$1.75	9x21x $\frac{1}{8}$	\$2.25
9x14x $\frac{1}{4}$	2.50	9x21x $\frac{1}{4}$	3.75
7x18x $\frac{1}{8}$	1.75	12x21x $\frac{1}{8}$	2.75
7x18x $\frac{1}{4}$	2.50	12x21x $\frac{1}{4}$	5.00

IMMEDIATE DELIVERY. Mail orders given prompt attention. If your dealer cannot supply you order direct from this ad.

THE RAY-DI-CO ORGANIZATION

1547D N. WELLS STREET,

CHICAGO, ILL., U.S.A.

KECO-RADIO STORAGE BATTERIES



Are the highest grade batteries built especially for wireless instruments.

Solid oak box, natural finish, highly varnished. 6 volt, 7 heavy "Cristol" plates per cell, 50 amps.

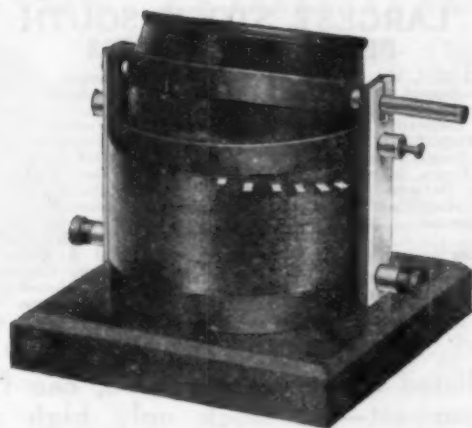
We are one of the largest builders of exclusive high grade Wireless Batteries in the country. Thousands in use. Sold by all leading dealers or shipped direct from factory, 15.75, with book of uses and abuses of the storage battery.

KALB ELECTRIC COMPANY

7323 MANCHESTER AVENUE,

ST. LOUIS, MO.

Price



\$5.00

Super Standard Vario Coupler

Single turn variations cover entire primary winding on the Formica tube. For both table and panel mounting. $\frac{1}{4}$ " Brass rods in Rotors. Binding post connections. Green silk wire. Range 150-600 Meters.

New Knob and Dial \$1.00—Sockets \$1.00

IMMEDIATE DELIVERY

New Non-Regenerative Set

In cabinet with detector unit included

\$32.50

MANUFACTURERS—JOBBER—DEALERS

OUR NEW CATALOG IS READY

Our new catalog is ready with complete descriptions and illustrations of our entire line. VARIOMETERS, VARIOCOUPERS, DETECTORS, AMPLIFIERS, DIALS, SOCKETS, RHEOSTATS, NON-REGENERATIVE RECEIVING SETS, BINDING POSTS, CONTACT KNOBS, STOP PINS, SWITCH LEVERS COMPLETE AND SMALL ACCESSORIES

We are territorial Distributors for Radio Corporation, Westinghouse, Magnavox, Baldwin, Remler, Cunningham, Riley-Klotz "ARKAY HORN", Federal, Rhamstine, Acme, Weston and Jewell Meters, Hipco B Batteries, Cooper storage Batteries, A. P. Tubes, etc.

Send us your Orders for Head Sets, Dials and Knobs, Sockets, Magnavox, Arkay Horns.

THE MARSHALL-GERKEN CO.

Manufacturers & Jobbers

TOLEDO

OHIO

RADIO APPARATUS

LARGEST STOCK SOUTH
PROMPT DELIVERIES

SERVICE

QUALITY

B. Batteries Radisco Small 22½ V.	\$1.50
B. Batteries Radisco large-tapped 22½ V.	2.65
B. Batteries Eveready large-tapped 22½ V.	3.00
Tubes UV200 Radiotron Detector	5.00
Tubes UV201 Radiotron Amplifier	6.50
Tubes UV202 Radiotron Trans-5 watt	8.00
Tubes UV203 Radiotron Trans. 50 watt	30.00
Tubes C300 Cunningham Detector	5.00
Tubes C301 Cunningham Amplifier	6.50
Tubes Electron Relay Detector	5.00
Tubes A & P Amplifier	6.50
Phones Murdock 2000-ohm	4.50
Phones Murdock 3000-ohm	5.50
Phones Brandes Superior	8.00
Phones Brandes Navy	14.00
Phones Baldwin Type C	12.00
Phones Baldwin Type E	13.00
Phones Baldwin Type F	14.00

Sockets Paragon	\$1.00
Sockets Murdock	1.00
Sockets G. A.	1.50
Sockets DeForest	1.20
Rheostats Paragon	1.50
Rheostats DeForest	1.65
Rheostats Gen. Radio	2.50
Rheostats Remler-Jr.	1.00
Remler Rheostat	1.50
Rheostats Parkin75
Corwin Dial & Knob 3"	1.00
Corwin Dial & Knob 3¼"	1.20
Dial and Knob Chelsea	1.00
Transformers, Acme Unmounted	4.50
Transformers, Acme Sem-mtd.	5.00
Transformers, Acme Mounted	7.00
Transformers, Federal	7.00
Transformers, UV712	7.00

We have only listed a few items above, can furnish anything required for your set—we stock only high grade products.

Acme Apparatus
Clapp-Eastham
DeForest
Wm. Murdock

Federal
Firth
Radio Dist. Co.
Radio Corp.

Brandes
Adams-Morgan
Chelsea
Magnavox

Remler
Signal
Eveready
N. Baldwin Co.

ROSE RADIO SUPPLY

604 GRAVIER STREET,

NEW ORLEANS, LA.

Send 10c for Catalog



Galena and Radiocite

Million point, supersensitive crystals from our own mine in Arizona. Used by all radio companies.

Radio Supplies BY MAIL

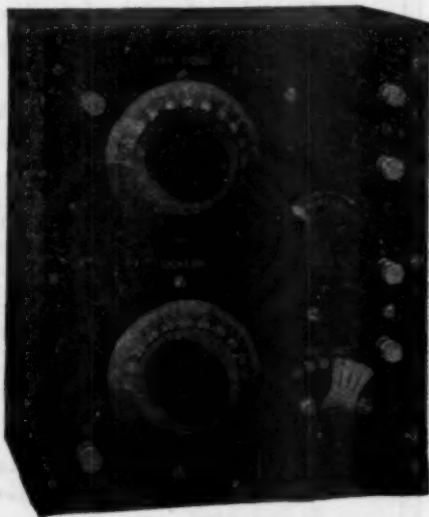
Crystals, mounted 30c, unmounted 25c.	
Condenser, fixed receiving	\$1.00
Insulators, aerial25
Binding Posts07c. up
Contact points	per 1000 \$15.00
Tuning Coils	\$3.50 & \$4.00

Mail orders promptly filled. All crystals carefully tested and inspected.

The RADIO SHOP of NEWARK

41 So. Orange Ave.,
Newark, N. J.

Clapp Eastham H R tuner



This tuner brings all the
RADIOFONE BROADCASTING
to your home. See it in Akron, Ohio, at

The Radioart Store

318 Ohio Bldg.

Radio 8UX

Greater Amplification

Than Any Other On The Market !

NO HOWLING !

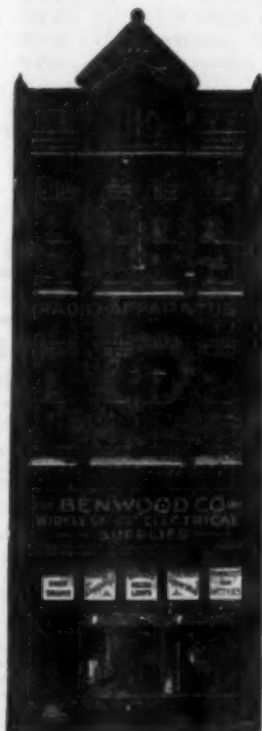
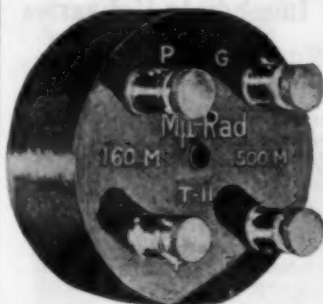
No Plate Circuit Tuning Adjustments

**Equally Effective on Phone, C.W. or Spark.
Radio Frequency Amplification at Short Wave
Lengths.**

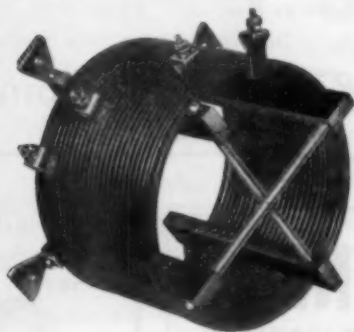
Here is a new departure in Radio Transformers. MU-RAD combines REGENERATION and straight R. F. AMPLIFICATION in a single unit. Type T-11 shown above can be used with any type of tube. With diagrams and full instructions, \$9.00 each.

Our Guarantee

We guarantee our T-11 Transformers to give greater amplification than any other on the market when properly used or you receive your money back.



THE above photo shows our new 3-story building in the heart of the St. Louis business district. Our mail order department is complete in itself and we give you immediate service on all mail orders. Send 10c in stamps for our catalog today.



**The Only "CW"
PANEL
INDUCTANCE
On The Market**

This is the only "C.W." Inductance made for panel mounting. The copper ribbon is wound on FORMICA supports, giving highest possible insulating qualities. Each Inductance furnished with four of the new type BENWOOD PATENTED HELIX CLIP which will fit either a round or flat surface. Each clip furnished with moulded insulated handle which enables tuning of the set with current on.

Standard size, as shown in cut, consists of 25 turns of edgewise wound soft drawn copper strip $\frac{3}{8}$ -inch in width and $\frac{1}{16}$ -inch in thickness. Turns are full 6-inches in diameter. Type A-1 (as shown)—each \$8.50. Type A-2—50 turns, ideal for stations requiring more than 250 meter wave, price each \$12.50.

**For Prompt Shipments—BENWOOD
"World Wide Mail Order Service"**

Our enormous mail order business has built up because of the service we render our customers. Your order will be filled at once or letter of notification will be sent you the same day explaining any cause for delay. Send 10c in stamps for the new Benwood Radio Catalog which comprises the latest price directory. We can show you how to save money by buying from us direct by mail.

**THE BENWOOD CO., INC., 1114 OLIVE STREET
ST. LOUIS, MO.**

T & H Radio Company

Largest Radio Stock In Mid-West

Immediate Deliveries

All items listed are in stock in large quantities.

CW APPARATUS

UV202 5 watt Radiotron	\$8.00
UV 203 50 watt Radiotron	30.00
UV216 Kenotron Tubes	7.50
UV217 Kenotron Tubes	26.50
UR542 Porcelain Socket	1.00
UR541 Porcelain Socket	2.50
PR535 Filament Rheostat	3.00
PR537 Filament Rheostat	10.00
UP1719 Grid Leak	1.10
UP1718 Grid Leak	1.65
Acme CW Inductance	8.00
Acme 200 Watt CW transformer	20.00
Acme 500 Watt Power Trans.....	25.00
Acme Choke Coils, single	6.00
Acme Choke Coils, double	8.00
Acme Modulation Transformer ...	5.00

RECEIVING APPARATUS

UV200 Radiotron, detector	\$5.00
UV201 Radiotron, amplifier	6.50
Electron Relay, detector	5.00
A. P. Amplifier tube	6.50
Grebe CR9 with amplifier	130.00
Grebe CR8 150-1000 meters	80.00
Grebe CR5 150-3000 meters	80.00
Magnavox, 14" horn	45.00
Burgess #2156 "B" Battery	3.00
Burgess Tapped "B" Battery ...	2.75
Baldwin Receivers type C	12.00
Baldwin Receivers type E	13.00
Baldwin Receivers type F	14.00
Brandes "Superior" receivers	8.00
Acme Amplifying transformers ..	5.00
Honey Comb Coils, all sizes	

Inquire for monthly stock sheet, shows our complete stock each month. ...CW and radiophone catalog sent any address when four cents in stamps accompanies inquiry.

5th District Distributors for Ideal Apparatus Co.

T & H Radio Company

ANTHONY,

9ZAC

KANSAS

RADIO PANELS

SAVE MONEY on our special 30 day offer. Our panels are made of genuine

BAKELITE DILECTO

XX Grade Black (Polished Surface)

used for the past 5 years as a standard WIRELESS insulation by U.S. Navy. Universally recognized by radio engineers as the most efficient insulation for radio sets.

We are specialists dealing exclusively in radio panels and have ready for immediate delivery the following sizes— $\frac{1}{8}$ inches thickness.

6 x 9 Price \$1.15	6 x 19 Price \$3.40
6 x 12 " 1.50	12 x 18 " 4.50
8 x 12 " 2.00	6 x 21 " 2.60
6 x 18 " 2.25	12 x 14 " 3.50
9 x 12 " 2.25	

We will cut special sizes to your specifications at 2½ cents square inch.

RADIO PANEL SPECIALTY CO.

Sales Office: 50 Church St., Room 1869, New York City

Enclosed find _____ for _____ Bakelite Panels _____ size _____

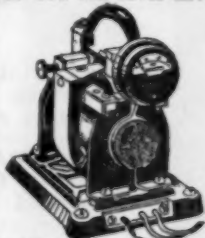
NAME _____

ADDRESS _____

CITY OR TOWN _____ STATE _____

10c. Charges Your Storage Battery AT HOME WITH AN F-F Booster

So You will never have to give up, in disgust when working a distant station.



Is it not gratifying to feel that your filament battery will always be ready when you want it? You know what its like to have friends call to "LISTEN IN" & then find your battery dead. F-F Battery Boosters are automatic and operate unattended. Screw plug in lamp socket, Snap Clips on Battery Terminals and see the gravity come up.

The AMMETER shows you just the amount of current flowing. Both waves of current are rectified thru adjustable and easily renewable carbon electrodes which maintain a constant efficiency and last for thousands of hours. Everything Complete in One Compact, Self-Contained, Portable Charging Unit. F-F Boosters are Magnetic Rectifiers for 105-125 Volt 60 Cycle Alternating Current. PRE-WAR PRICES: Bantam Type 6 charges 6 Volt Battery at 6 Amperes \$15 Bantam Type 12 charges 12 Volt Battery at 5 Amperes \$15 Type 166 Charges 6 Volt Battery at 12 Amperes \$24 Type 1612 Charges 12 Volt Battery at 7 Amperes \$24 Type 1626 Charges Both 6 and 12 Volt Batteries \$36

Shipping Weights Complete 12 to 15 Pounds

Order from your Dealer or send check for Prompt Express Shipment. If via Parcel Post have remittance include Postage and Insurance Charges. Or have us ship C.O.D. Other F-F Battery Boosters charge batteries from Farm Lighting Plants, Direct Current Circuits and D.C. Generators. For Group Charging use our Full Wave Automatic F-F Rotary Rectifier of 100 Volt, 36 cell capacity.

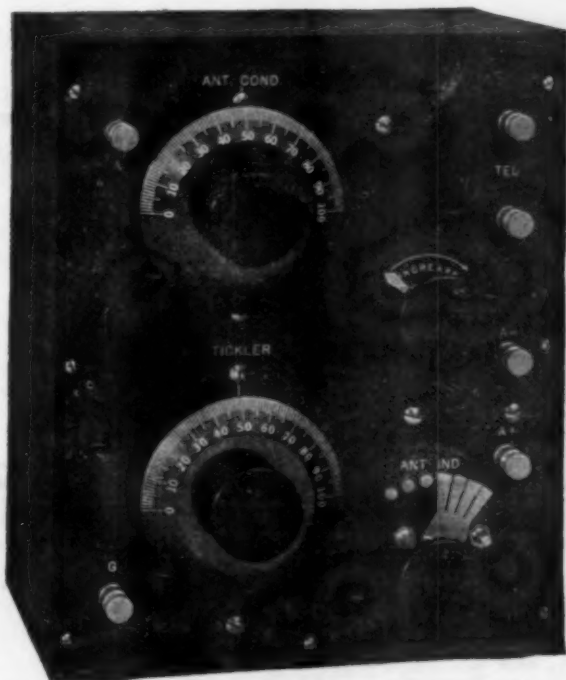
Order Now or Write for Free BOOSTER Bulletin No. 31 or ROTARY 31A

The France Mfg. Co. OFFICES & WORKS

CLEVELAND, OHIO, U.S.A.

Canadian Representation: Battery Service & Sales Co. Hamilton, Ontario, Can.

Here's The Receiving Set You Are Looking For—



Licensed Under Armstrong U. S. Patent
No. 1,113,149

The specifications tell the story to the expert and the C-E guarantee of satisfaction protects every purchaser of a Clapp-Eastham Type H. R. Regenerative Receiving Set—expert and amateur alike.

If you're looking for 100% satisfaction—regardless of price—ask your dealer to show you this set. He may be temporarily out, but it's well worth waiting for—or you can write us direct.

If you haven't already received a copy, you should send 6c in stamps for the C-E Radio Catalog—it covers every essential radio requirement.

CLAPP-EASTHAM COMPANY

RADIO ENGINEERS *and* MANUFACTURERS

114 MAIN STREET,

CAMBRIDGE, MASS.

THE CLAPP-EASTHAM TYPE H. R. REGENERATIVE RECEIVER

PRICE \$40.00

You can pay more money for a receiving set—if you want to—but you can't get any better results or greater satisfaction at any price.

Since we put this set on the market, we've been literally swamped with orders. Dealers, radio "fans," novices—everybody who has tried the instrument has become a booster for it.

Regeneration is perfect on all wave lengths between 180 and 825 meters. The range or distance from which signals are received and the clear, sharp tones are a revelation to the experienced radio man as well as to the person who "listens in" for the first time.

Panel-- Formica, hand-somely decorated.

Cabinet-- Solid Mahogany.

Condenser-- Balanced type, 2 Rotary, 3 Stationary plates. Built on Vernier.

Dials-- Indestructible metal. White figures on black ground.

Antenna Inductance-- Wound in Formica Tube.

Plate Inductance-- Wound on molded ball.

Binding Posts-- Black rubber covered.

Switch-- Fan Blade.

Rheostat-- C. E. Type H 400.

Circuit-- Single circuit regeneration. Licensed under Armstrong U. S. Patent No. 1,113,149.

"B" Battery-- Contained in compartment inside cabinet or external as desired.

DEALERS GET SPECIAL PROPOSITION

Send to KLAUS—"Radio Headquarters" for special discount lists and bulletins on apparatus and equipment. Our service department offers dealers assistance and advice on radio problems. We distribute "tested" apparatus. We know the equipment we send you is right. We want all Agents and Dealers to get our special proposition on the best lines of apparatus made.

Get our Prices on these lines of apparatus

Acme
Adams-Morgan
Baldwin
Brandes
Westinghouse

Clapp-Eastham
DeForest
Jewell
Federal
Radio Corporation

Grebe
Moorhead
Murdock
Pacnet



Write today to---

KLAUS RADIO CO.

Dept. 100

Eureka,

Illinois



FIRST TESTED THEN SOLD

AMATEURS, EXPERMENTERS, DEALERS

We beg to announce our appointment as distributors for
**BALDWIN, BRANDES, MURDOCK, CLAPP-EASTHAM, CHELSEA,
FIRTH, A B C, DEFOREST, MARSHALL-GERKEN and others**
SPECIAL THIS MONTH

Bakelite Cut any size— $\frac{1}{8}$, $\frac{1}{4}$, and $\frac{3}{8}$, 1 $\frac{1}{2}$ c, 2c and 2 $\frac{1}{2}$ c per square inch.
Mail Orders Promptly Filled.

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112 DIAMOND STREET,

PITTSBURGH, PA.

"Pittsburgh's Radio Shop"
Exclusive 8th District Distributors for
"IDEAL" C W APPARATUS



Radio Frequency Transformers

Type RT-1, for the amateur and broad-casting range, 175-500 meters.
(Patent Pending)

\$6.00

Will work on all tubes.

The only completely shielded iron-core
R. F. Transformer

RADIO SERVICE LABORATORIES, Inc.
ASBURY PARK, NEW JERSEY



New "Read 'Em" Binding Posts

16 Styles

Antenna

Ground

Condenser

Tickler

Variable Condenser

A—Battery—

A—Battery+

B—Battery—

B—Battery+

Plate

Detector

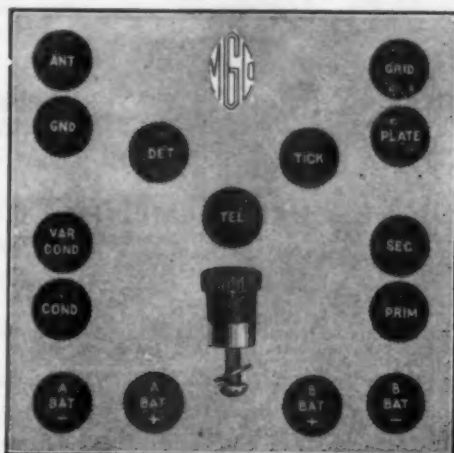
Phones

Secondary

Primary

Grid

Filament



Complete Post and Knob 15c each

The enormous demand for these "read 'Em" binding posts, prompted us to put in a large stock to take care of our friends. Our stock is complete.

We are in equally fine position to fill orders promptly for binding posts made up of exactly the same high grade material and workmanship—the same in every way, without the knob engraved @ 12c. each.



SWITCH ARM TYPE S. A. 3

Price\$.50 Each

Knob—1 1/4" Knurled Bakelite

Lever—1 1/2" Phosphor Bronze Nickle

Bushing—to fit up to 3/8" panel.

Type S. A. 1—Price.....\$.40 Each

Same as above with 1" radius knob.



SWITCH ARM TYPE S. A. 4

Price\$.50 Each

Knob—1 1/4" Fluted Bakelite

Lever—1 1/2" Phosphor Bronze Nickle

Bushing—to fit up to 3/8" panel.

Type S. A. 2—Price.....\$.40 Each

Same as above with 1" radius knob.

Send Us Your Orders Now

Orders will be shipped the day they are received. Send in your order early.

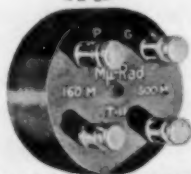
THE KUEBLER RADIO COMPANY

124 St. Clair Street

Toledo, Ohio

Mu-Rad RADIO Laboratories

R. F. TRANSFORMERS
Types T-11, T-11a, T-11b



WAVELENGTH RANGE
160-500 meters

RADIO FREQUENCY AMPLIFICATION

Introducing two new MU-RAD R.F. amplifier transformers Type T-11a and T-11b. We have again anticipated the entire field in multi-stage R.F. amplifier design. Users already know the fine results obtained by using two or three MU-RAD T-11 transformers for 2 or 3 stage amplification; but we have developed and protected our rights in a method for obtaining still greater amplification. The load in the plate circuit of a vacuum tube is reflected into the grid circuit thru the grid-plate capacity, and maximum amplification for more than one stage can therefore only be obtained by proper recognition of this fact in its influence upon the design of the transformers in each stage. Other manufacturers use the same transformers in every stage. MU-RAD uses different transformers for SUPER-AMPLIFICATION.

For one stage amplification, use Type T-11 between amplifier tube and detector. (Usually equivalent to two stages with other transformers.)

For two stage amplification, use T-11a between first and second amplifier tubes and Type T-11 between second amplifier tube and detector.

For Three stage amplification, use Type T-11b between first and second amplifier tubes, Type T-11a between second and third amplifier tubes, and Type T-11 between third amplifier tube and detector. DEALERS: Write.

R.F. Amplifier transformer Type T-11	\$6.00
R.F. Amplifier transformer Type T-11a	6.50
R.F. Amplifier transformer Type T-11b	7.00

MU-RAD LABORATORIES, Asbury Park, New Jersey; St. Louis, Mo.
THE BENWOOD COMPANY, Inc., ST. LOUIS, MO. Distributors west of Mississippi River.

Ask Sorsinc



The highly professional service which our seasoned radio men give—backed by complete stocks of the leading lines of equipment make it well worth your while to ask

SORSINC

before buying. We know from experience what each piece of apparatus will do.

Our Interesting Booklet

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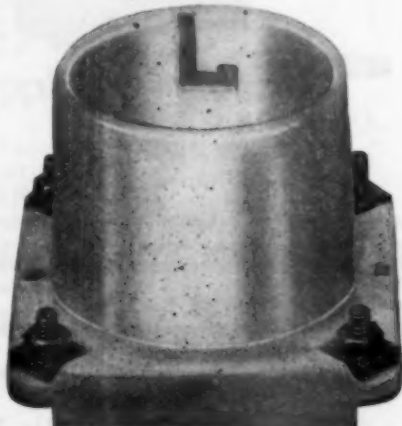
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Branch Offices and Dealers Everywhere
"THE LARGEST RADIO CHAIN STORE SYSTEM IN THE WORLD"

SORSINC, 80 Washington St., New York, N. Y.
Herewith 6 cents in stamps to pay mailing expense on my copy of your latest booklet.

Q-4-2

The Original - At The New Price

50 cents each



The original socket with the concealed bayonet slot.

The old adage: "Imitation is the sincerest form of flattery" still holds!

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"We give all we can for what we get—
—instead of—
—getting all we can for what we give."



The Prince of Wales

could well be called the world's greatest known press-agent. With much pomp and ceremony he is received everywhere.

Your order received, "pomp" becomes "prompt" and the ceremony consists of the service we render our customers.

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No. CR-3 Grebe Relay-special 175-680 meters	\$65.00
No. CR-5 Grebe super-special 175-3000 meters with detector complete	80.00
No. CR-8 Grebe 175-1000 meters with detector latest type short wave set	80.00
No. CR-9 Grebe 175-3000 meters complete with det. & 2 stage amplifier	130.00
No. CR-6 Grebe 175-680 meters with det. and 2 stage amp. phone & series cond.	200.00
No. RA Westinghouse, 180-700 meters, very selective, mahogany cabinet	68.00
No. RC Westinghouse, RA receiver and DA Det. Amplifier combined in one cabinet, a splendid unit, compact	130.00

KENNEDY EQUIPMENT	
Type 110 Universal	\$250.00
Type 2201 Intermediate	125.00
Type 281 Short Wave	80.00
Type 525 Amplifier	85.00
Type 521 Amplifier	55.00

RECEIVING SETS (Crystal)	
"Aeriola Jr." Westinghouse, complete with Brandes "Superior" phones	\$25.00
"Radiola" DeForest, complete with Brandes "Superior" phones	25.00

VACUUM TUBES	
No. UV-200 Radiotron detector	\$6.00
No. UV-201 Radiotron amplifier	6.50
No. UV-202 Radiotron 5 watt	8.00
No. UV-203 Radiotron 50 watt	30.00
No. UV-204 Radiotron 250 watt	110.00

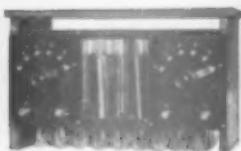
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No. 763 Eveready 22½ volts	\$2.25
No. 766 Eveready 22½ volts tapped ..	3.00
No. 5158 Burgess 22½ volts tapped ..	3.00
No. 2156 Burgess 22½ extra large ..	3.50

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No. 56 Murdock 2000 ohm	\$5.00
No. 56 Murdock 3000 ohm	6.00
No. C Baldwins	12.00
No. E Baldwins	13.00
No. F Baldwins	14.00
No. G Baldwins new style static-proof ..	15.00
No. C Baldwins single unit only	6.00
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No. Brandes "Transatlantic" type	12.00
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A complete stock of standard apparatus enables us to fill your most exacting needs

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Storage Batteries

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"Cheapest in the long run"



KICO "B" BATTERIES

KICO storage "B" batteries will end your "B" battery troubles. YEARS of Real service, saving you money in the end. One charge lasts from three to six months while in your detector plate circuit. Short-circuiting, over-charging or standing idle DOES THEM NO HARM. Durably constructed of the best materials and highly finished making a piece of apparatus which will fit in any station. Can be charged from your A.C. line in one hour after the first charge which takes about four hours. All batteries are supplied with chemicals, rectifiers and directions for setting up. One quart of distilled water puts your battery into service. Money back if unsatisfied within three months trial. Prices as follows

	Plain	With Panels
24 cells 32 V.	\$8.00	\$11.00
36 cells 48 V.	10.00	13.00
54 cells 66 V.	12.00	16.00

KICO "A" BATTERIES

No more ACID EATEN rugs or furniture. Truly a PARLOR battery, designed especially for wireless den, yet sturdy enough to kick over starter on Ford, Chevrolet or any car taking a battery 9"x7". Box and jars moulded in one piece from ACID-PROOF composition much tougher than hard rubber. A Box that will NOT crack, break or leak in battery use. 6 volt 80 to 100 A.H. capacity, guaranteed for 18 months but will last for years if used only for wireless @ \$24.00

We also manufacture the following sizes designed especially for C.W. work, assembled in especially treated, durable hard wood boxes with hard rubber jars and covers with deep sealing space, sealed with great care to prevent leakage. Guaranteed 18 months.

6 volt 80-100 A.H.	\$20.50
8 volt 80-100 A.H.	27.00
10 volt 80-100 A.H.	33.00

Batteries shipped fully charged ready for use with hydrometer and full instruction for upkeep. Special sizes built to your specifications.

Circulars furnished upon request.

KIMLEY ELECTRIC CO., 290 Winslow Ave., Buffalo, N. Y.

For REAL Service

Mail your orders to us. We can supply you with the BEST at the BEST PRICES. Shipments made within 24 hours after receipt of order.

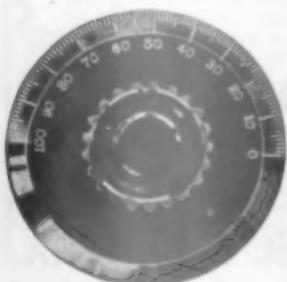
CATALOGUE
\$22
AT YOUR
SERVICE

THE SERVICE RADIO EQUIPMENT CO.

Designers—Manufacturers—Distributors

225 SUPERIOR ST.,

TOLEDO, OHIO



Dial No. 23

THE QUALITY DIAL

Diameter 3"

Made for 3/16" and 1/4" Shafts.

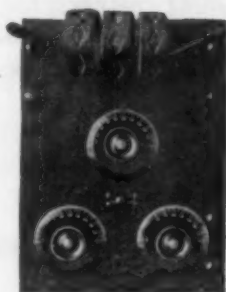
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THE RADIO ELECTRIC COMPANY

3807 Fifth Ave., W.

PITTSBURGH, PA.

Type "Q" Receiver



AN IDEAL RECEIVING SET FOR LONG AND SHORT WAVE AND RADIO TELEPHONE RECEPTION

This set is the most flexible receiving set on the market. With the use of the various sizes of Honeycomb Coils everything in the range of radio telegraph and telephone reception from 200 to 25,000 meters is brought into your home. Consists of a three coil mounting, and three Variable Condensers of proper capacity. Tuning extremely sharp. Remler dials.

Price without Detector.....\$35.00

Duck's New Radio Catalog No. 16



Send 25c in coin carefully wrapped today for copy of the greatest radio catalog ever put between the pages of two covers.

275 Pages--A Catalog DeLuxe

Never in the history of radio was such a catalog printed. The radio data and diagrams embracing upwards of fifty pages, gives the experimenter more valuable and up-to-date information than will be found in many text books selling for \$2.00, and \$1.00 could be spent for a dozen different radio catalogs before you could gather together the comprehensive listing of worth while radio goods found in this great catalog.

A brief summary of the radio goods listed in this catalog:

The entire radio catalog of the Radio Corporation, with a wealth of scientific and technical data on C.W. transmitting sets, and all the diagrams for the assembling of these sets; the complete Remler catalog, which embraces 25 pages, the Westinghouse, Firth, Murdock, Federal, DeForest, Clapp-Eastham, Brandes, Connecticut Company, Thordarson, Turney, Magnavox Company catalogs, the best products of Adams-Morgan, Signal and countless other manufacturers, including our own complete line of radio apparatus, and many individual items and parts used in radio work today.

Send 25c in coin, (carefully wrapped) for new catalog. The great cost of this elaborate catalog prohibits distribution on any other basis.

The William B. Duck Company

243-245 Superior Street

Toledo, Ohio



Type TAW, Flush Model

A New Bulletin

ON SMALL RADIO INSTRUMENTS

is now ready. It covers not only our line of three and onehalf inch **thermal** instruments, but also our lines of A.C. and D.C. instruments in the same size cases. All ranges required in modern radio work are included. You will be interested in this Bulletin which gives full details. In writing us mention Bulletin No. AG-10. **IT IS FREE!**

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Electrical Instruments, Meters and Circuit Breakers



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ACE "ACE RADIO CONCERT RECEPTOR" **ACE**



Type TRU Concert Receptor \$50.00

(Licensed under Armstrong Patent 1,113,149)
This unit is especially designed for the efficient reception of Radio Telephone Concerts from even the most distant Broadcasting Stations. The ease with which this Receptor can be installed and the extreme simplicity of operation make it ideal for use by even the most in-experienced. No previous knowledge of radio necessary to secure results.

We stock a complete line of Radio Supplies and maintain a prompt, reliable Mail Order Service that reaches all over the world.

Send 5c in stamps for catalog to Dept. "D".

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Manufacturers & Distributors of Radio Apparatus

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Prepared Radio Measurements

with
Self Computing Charts

by Ralph R. Batcher

A new WIRELESS PRESS book. Published as a real help to amateur radio. Obviates the necessity of long and involved mathematical calculations. A ruler or transparent triangle takes the place of intricate figuring and the results will be correct every time.

PRICE \$2.00

The WIRELESS AGE

The magazine that meets
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When its new you find it in the AGE. Every step in radio progress is fully and carefully described. You miss a lot of good things unless you read the AGE. \$2.50 per year, Postage outside U. S. 50c.

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Prepared
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1 Year

\$4.00

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50c. Extra

This offer expires Dec. 15, 1921.

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Signal Service To Radio Electricians

Signal Radio Apparatus is *built complete* in Signal shops from designs developed in the Signal Laboratory by Signal Radio Engineers.

Before you spend a dollar on Radio equipment, check up the *Signal Line* against the field and the first step is to secure all Signal Literature. It's free—write today.

Write today for latest literature and name of nearest dealer.

Signal Electric Manufacturing Company
Menominee, Michigan

EBY BINDING POSTS AGAIN MADE A TREMENDOUS HIT AT THE NEW YORK RADIO SHOW



Corporal
(Brass—13c)
with stud & nut



Sergeant
(Brass—20c)
with
screw & washer

Our 4 latest posts (BUDDY, SERGEANT, JUNIOR and JUNIOR H) sure won the hearty approval of every manufacturer, dealer and amateur who saw them at the SHOW..

The 4 posts shown are especially suitable for RADIO use and our increased facilities enable us to NOW MAKE PROMPT DELIVERIES.

LEADING MANUFACTURERS have adopted our posts and DEALERS everywhere are carrying an attractive stock.

To the AMATEUR who is building his own, here's your chance to equip your set with THE BEST BINDING POST ON THE MARKET. Ask your dealer to show you THE EBY LINE.

EBY POSTS SERVE, SAVE AND SATISFY



Junior—15c
(Including nut)



Ensign H—20c

THE H. H. EBY MANUFACTURING CO., 605 ARCH ST., PHILADELPHIA, PA.

DEALERS AND RADIO CITIZENS

Order Your Needs From Our

LARGE AND COMPLETE ASSORTED STOCK

PARTS OF ALL KINDS

COMPLETE SETS

LARGEST STOCK RADIOTRONS AND KENOTRONS IN U. S. A.

ALL TUBES SHIPPED PREPAID

Write for our new price list No. 100-T



LUDWIG HOMMEL & CO.

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PROMPT SHIPMENTS FROM

"DEL FELCO"

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Radio Special Storage Batteries

4 Volt, 60 Amp.....	\$10.00
6 Volt, 40 Amp.....	12.00
6 Volt, 60 Amp.....	14.00
8 Volt, 60 Amp.....	18.00

Fully Charged. F.O.B. Boston. No Charge
For Crating.

Guaranteed for One Year

Manufactured by

W. & G. TUFTS

336 Newbury St.,

Boston, Mass.

Read what Godley says

Radio Corporation of America
233 Broadway
New York City,

As the representative of the American Radio Relay League in England during the recent Trans-Atlantic Amateur Transmission Tests, I wish to call your attention to the assistance given by all members of your organization from whom assistance was asked, and the cheerful, wholehearted manner in which it was given.

I have endeavored, both in the written accounts of my experiences as well as in verbal reports of it, to point out the great value of this assistance, and to call attention to the fact that Radio Corporation Detector Tubes Type **UV 200** were used during the reception at Ardrossan in conjunction with the regenerative receiver and 2-stage tone, frequency amplifier. These tubes functioned admirably, and the results obtainable was a surprise to the several British amateurs who saw them in operation.

All Radio Relay men with whom I have spoken concerning the matter since my return are deeply grateful for the co-operation given by your company, and fully appreciate that the completeness of the success of the venture would have been lacking in great degree but for your co-operation.

Respectfully,

Paul F. Godley



It was a great triumph for the amateurs when they sent messages across the Atlantic to Scotland. But it was also a Radiotron triumph. Read what Paul F. Godley says in the letter here reproduced in facsimile.

There are two Radiotrons available for reception. For Detection — Radiotron UV—200, the popular tube used by thou-

sands of amateurs and novices because of its long life and super-sensitiveness. Price \$5.

For Amplification — Radiotron UV—201, the amplifier tube which gives maximum amplification without distortion and which, like UV—200, is used throughout the nation for radiophone broadcasting reception. Price \$6.50.

Ask your nearest Dealer for Radiotrons

Radio  **Corporation**
of America
Sales Department, Suite 1803
233 Broadway, New York City



RHAMSTINE*

PRODUCED THE

ADAPT-O-PHONE

FOR A LISTENING WORLD

Developed from a special study of the requirements of a Radio Age, the Rhamstine* Adapt-O-Phone brings added satisfaction to your hours "listening in."

Scientifically designed and balanced so that the sounds from your two receivers are clearly and correctly amplified. The Adapt-O-Phone is twenty inches high, attractively finished and reasonably priced.

Price \$12

without receivers
Add 25c for Postage and Packing;
west of Rocky Mts., 40c.

J. THOS. RHAMSTINE*

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DETROIT, MICH.

*Maker of Radio Products

Keep Your Battery Fully charged

WITH A

Riggs Rectifier

The simplest, lowest priced and most efficient RECTIFIER on the market. Has only ONE adjustment and is absolutely fool proof.

No amateur wireless outfit, or up to date private garage is complete without this RECTIFIER, by means of which your wireless, or automobile battery is kept fully charged.

Sent parcels post East of the Rocky Mountains upon receipt of price,

\$12.50

Your money back, if you are not FULLY SATISFIED

THE RIGGS MFG. CO.

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Attractive Proposition to Dealers

When you think of Radio think of JONES

I am located in my new store and carry a large stock of all standard makes of sets and parts.

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2200 ohms\$8.00
Brandes Superior
2200 ohms 8.00
Brandes Navy
3200 ohms14.00
Federal 53-W
2200 ohms 8.00
Federal 52-W
3200 ohms10.50

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Chelsea 24 4.25
General Radio
2247A 5.50

DETECTOR BULBS

Radiotron UV200 ..\$5.00
Electron Relay .. 5.00

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General Electric
Crystal\$18.00
DeForest Crystal ..25.00
Aeriola Jr. 25.00
Federal Jr. 25.00

TRANSFORMERS

Chelsea Radio\$4.50
General Radio 5.00
Coto-Coil 5.00
Amrad 6.00
Moorhead V.T.-1.. 6.50

AMPLIFYING BULBS

Radiotron UV 201..\$6.50
Moorhead V.T.-1. 6.50

Parts for making your own Regenerative Receiving Set

Bakelite Variometer wound.....\$8.00
Bakelite Bank-wound inductance..... 4.50
Switch arm—double arm..... .75

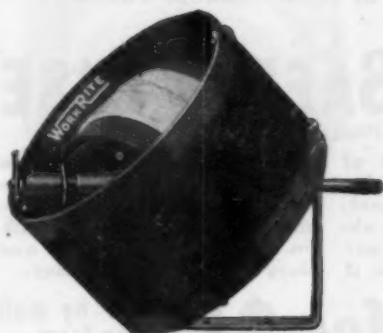
Also a complete line of small parts.

JAMES H. JONES

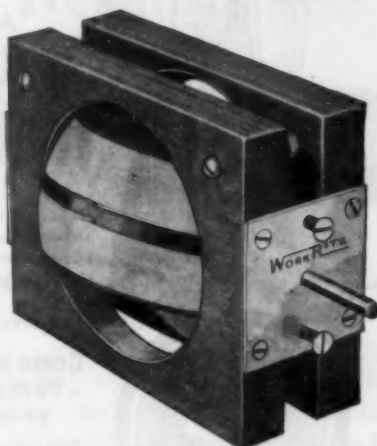
Radio Apparatus

94 Massachusetts Ave., Boston, Mass.

"WORKRITE PRODUCTS WORKRITE"



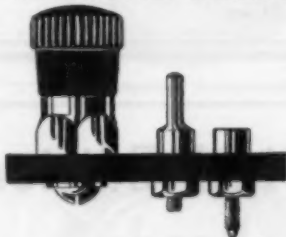
Finest
Material
Finest
Workmanship
Finest
Finish



Here is the "Tuner Team" that radio fans have been going wild over wherever shown. Most dealers have their entire allotment sold before shipment is received. "They certainly do Workrite" is the verdict of all users.

One Workrite Variocoupler and two Workrite Variometers are guaranteed to give you a tuner that cannot be excelled by anything on the market.

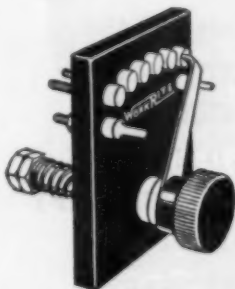
WORKRITE VARIOCOUPLER OR VARIOMETER IN ATTRACTIVE BOXES \$6.00 EACH



Workrite Binding Posts.....\$0.12

Workrite Switch Points......04

Workrite Switch Stops......06



Just what you want. Remove the parts and use the block as a template for drilling your panel. Put up in neat individual boxes. Complete Workrite Switch Sets, \$1.00. Switch arm only, with bushing, 50c.

TYPE "A" WORKRITE HYDROMETER

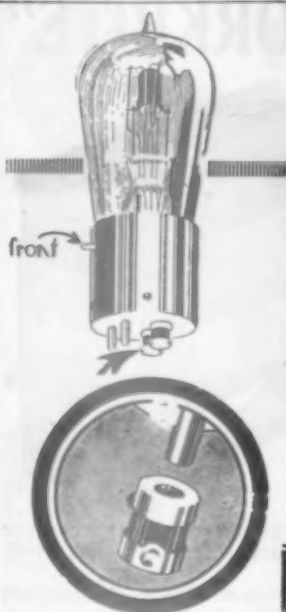
Double the life of your battery by giving it proper care. Fill and test it regularly with a Workrite Hydrometer. Never let it become discharged below 1150, or it will soon be ruined. Full instructions for testing and care of battery with each "WORKRITE." Get one now! Price, \$1.00



Insist that your dealer furnish a "WORKRITE." Accept no substitute. If he cannot supply you, we will ship direct by mail prepaid.

JOBBER AND DEALERS—Write or Wire for Discounts

The WORKRITE Mfg. Co., 5603 Euclid Ave.
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You Need Never "Burn Out" a Tube!

At few cents cost you can have absolute protection of your Vacuum Tubes with the new

RADECO SAFETY FUSE

(Patent pending)

Placed where every bit of juice must go through it before reaching the filament, this tiny fuse makes it absolutely impossible for any excessive amperage, even if

from accidental "short", to burn out a filament. Fuse clips directly on filament terminals of any standard bulb in any standard socket and does not affect efficiency.

Come only in
Packages
of four

4 for \$1

Order by mail
or from
your dealer

Carrying capacity 1-2, 3-4, 1, 1 1-2, 2, 2 1-2, and 3 amperes.

DEALERS!

Order this "live" one while we have stock on hand for quick delivery. Write today for dealer's prices.

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New England's Oldest Exclusive Radio Store

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Introducing the
Radio Hookswitch



"Gee-whiz
I FORGOT TO
TURN OFF MY
TUBES

Good night
Battery!"

How many
times, Brother
Amateur, have
you spoken the
above words?
But you will
forget no more
—NO, you will

Pat. Applied for
not even have to remember. We have solved
the problem for you, and besides have found the
most convenient and inconspicuous place for
your 'phones; on a hook under the edge of
the table. The Universal 'Radio Hookswitch'
simultaneously acts as a phone hook and a
vacuum tube switch. More than one may be
connected in parallel. Complete with screws
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Type R-2 6V-60A.H.....\$20.00

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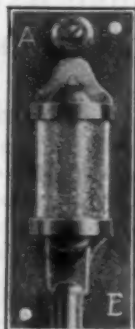
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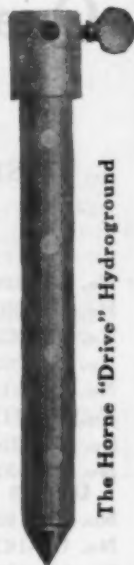
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SERIES	TRANSMIT	RECEIVE
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TICKLER	GRID VARIOMETER	PLATE VARIOMETER
SECONDARY CONDENSER	B BATTERY - +	A BATTERY - +
OUTPUT	INPUT	PRIMARY CONDENSER
TELEPHONE	PARALLEL	DETECTOR TUBE
+ -	COUPLING	

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There are many radio catalogs, but the "Rasco" catalog marks a radical change for the simple reason that it

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This is the one and only radio catalog containing such wonderful free information. Complete hook-ups of all important vacuum tube circuits are given in clear diagrams with complete explanation. Just to name a few.—The V.T. as a detector; detector and one-step amplifier; regenerative circuit; DeForest ultraudion; V.T. to receive undamped and spark signals; Armstrong circuits; one step radio frequency amplifier and detector; three stage audio-frequency amplifier; short wave regenerative circuits; V.T. radio telephone; 4-stage radio frequency amplifiers; radio and audio frequency amplifier, inductively coupled amplifier; Armstrong superautodyne; radio frequency amplifier and crystal detector; C.W. transmitters; self-rectifying 2 tube C.W. transmitter; V.T. transmitter with 6 volt battery; radiophone using plate and grid modulation; one tube radio transmitter and receiver; experimental radiophone; radiophone using Colpitts oscillator circuit.

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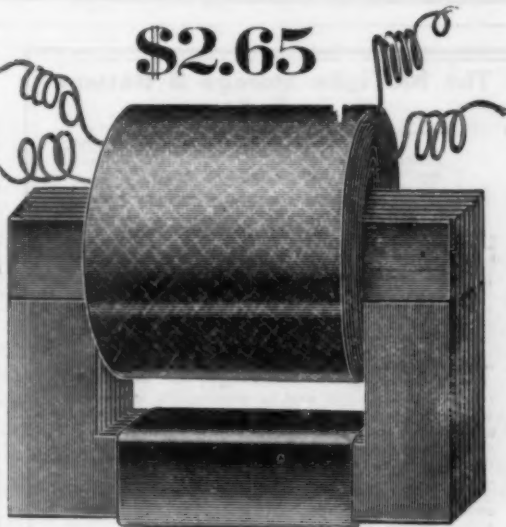
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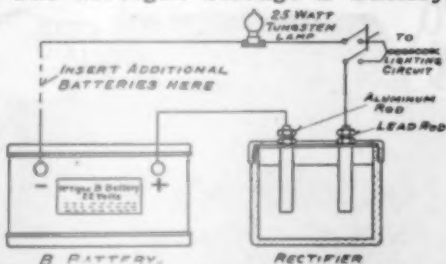
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If you want to make your present spark set approach a C.W. set for results:

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10 ins.	10 ins.	$\frac{1}{8}$ in.	1 $\frac{1}{2}$ lbs.	2.62
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5 ins.	2 $\frac{1}{2}$ ins.	$\frac{1}{4}$ in.	2 oz.	.24
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If it doesn't bear the yellow label, it isn't L. P. F.

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BACK COPIES PREVIOUS TO DECEMBER 1921 ARE NOT AVAILABLE

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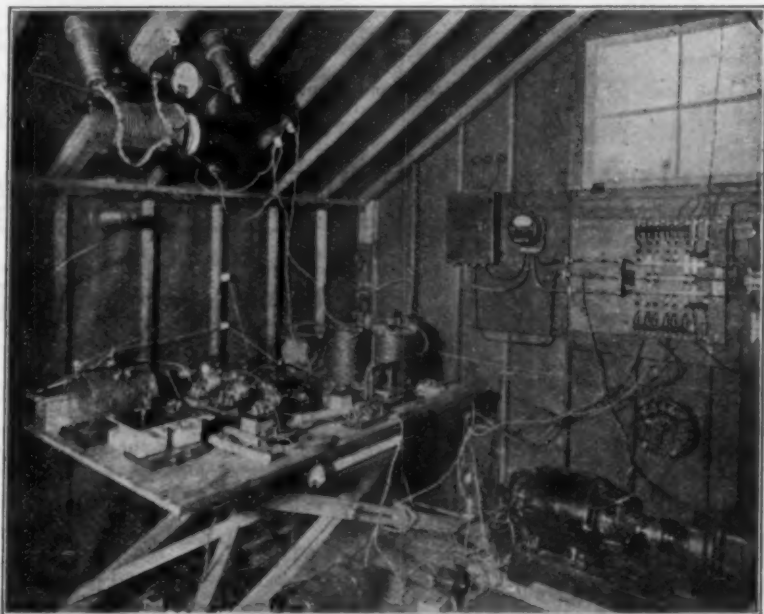
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Entirely complete ready to operate.
Parts cost as much as the finished ultra efficient high power amplifier.

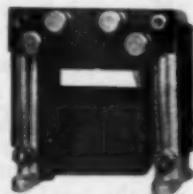
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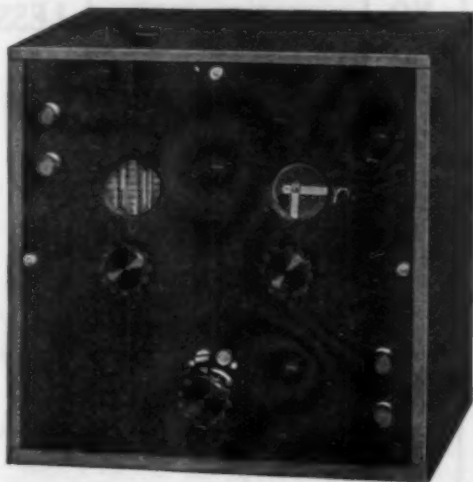
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Clapp-Eastham Co.

Westinghouse Mfg. Co.

Wm. J. Murdock Co.

Acme Apparatus Co.

American Radio & Research Corp.

Chelsea Radio Co.

Baldwin Phones

Eveready and Hipwell Batteries

Brandes Phones

DeForest Company

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Sole Manufacturers of Hall Relays and Recording Apparatus

The newest addition to the K line of wireless instruments is the K Vernier Attachment, a universal type, in that it is adaptable to any style condenser and dial. A small handsome knob that takes little room, does not project unduly, and does not "clutter" up the receiving panel.

There is no set in existence that is not improved wonderfully by the addition of this little device. In tuning CW and radiophones, a difficulty often experienced with the standard condenser is the impossibility of securing that exact adjustment required to bring in the music clearly, and free of troublesome and disconcerting back-wave screeches. The K-35 Vernier Attachment eliminates this. After a coarse adjustment by means of the dial, the little vernier button is pressed forward, and a slight turn either way, as needed, serves to bring in a maximum signal of clearness not obtainable by the first adjustment.

The K-35 Vernier Attachment is suitable for any instrument using a dial control.

K-35 Vernier Attachment, complete—45c—six for \$2.50—(Plus postage)

"Cootie" Key

We were the Originators of the
"The Universal Vernier Attachment"

Unit Cabinet Receivers

KARLOWA RADIO CO.

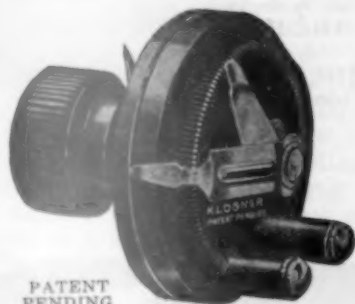
Main Office—606 BEST BLDG.,

ROCK ISLAND, ILL.

J. Edward Jones—Box 22—Palo Alto, Cal.—Pacific Coast Distributor

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MAKE NO MISTAKE THE KLOSNER VERNIER RHEOSTAT



PATENT
PENDING

is the only Vernier Rheostat made having the exclusive feature of using but

ONE SINGLE KNOB

for both rough and fine adjustments. This feature allows the symmetrical appearance of the single knob to be retained when mounted on a panel with other instruments, and, at the same time adds to the simplicity and ease of operation in obtaining the necessary fine adjustments for best results from the modern critical vacuum tubes, especially when receiving phone and C.W. signals.

We invite comparison with any other filament rheostat now made. Look for the name KLOSNER moulded on the base.

Your dealer has them or send direct to us.

PRICE \$1.50

Shipping weight, One pound.

A two cent stamp brings interesting literature.

Made only by the Originators.

The Klosner Improved Apparatus Company

Dept. Q4

2404 Crotona Ave., New York City
N. Y.

WARREN RADIO LOOP

NO
A
E
R
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A
L



LESS
S
T
A
T
I
C

If Dad says—

"NO AERIAL ON THIS HOUSE"

don't allow his QRM to worry you but purchase a

WARREN RADIO LOOP

The LOOP that made the Radio Roller Chair famous on the Boardwalk at Asbury Park, N. J.

Is just the thing for an apartment or den.

Is light in weight and easily portable.

Is produced under a new principle of winding.

Is wholly enclosed, thereby protecting the winding.

Is used in place of an outside aerial.

Is a regular indoor aerial.

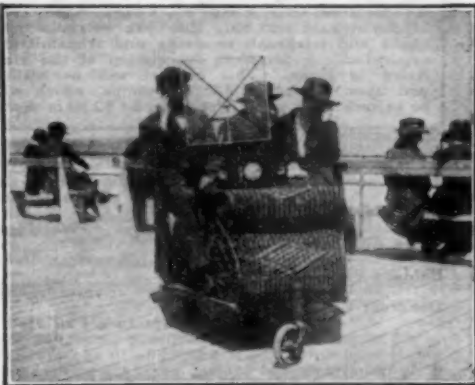
Is adapted for receiving in moving vehicles.

Takes the "tic" from static.

Eliminates all danger from lightning.

Can be used with any receiving instrument.

Can be used without tuner.



This picture of the Radio Roller Chair showing the Warren Radio LOOP was used as cover designs on "Wireless Age" and "Radio News" and featured in many other magazine and newspapers in the United States.

Send your order through your dealer or direct to us with his name.

Type-A-737 (300-700 meters) . . . \$10.00

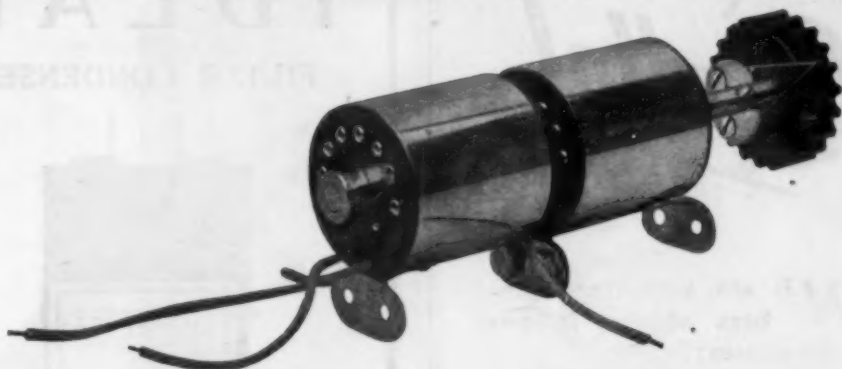
Type-A-7236 (175-1000 meters) . . \$12.00

V-DE-CO RADIO MFG. CO.

DEPT. R, ASBURY PARK, N. J.

Send for bulletin—No. AIOI

Radio Frequency Amplifier



Pat. Appld. For

There is nothing that opens up a wider field on the receiving end for the amateur and experimenter, than radio frequency amplification.

After an extensive investigation of the various types of tube couplings possible for radio frequency amplification, we have developed the above units (two are shown) with a view to giving maximum efficiency and greatest ease of control, at a reasonable price.

Tuning each stage is not necessary. Only one adjustment necessary to cover fairly wide bands of wave-lengths with several stages.

Transformers for several stages can be mounted in tandem with single control which greatly simplifies the manipulation of the set.

Remember that radio frequency amplification will increase the range, the selectivity and the satisfaction you can get from your receiver. A loop antenna will be far more effective with radio frequency amplification.

These units will cover wave-lengths from 180 to 750 meters.

TYPE 5000 RADIO FREQUENCY AMPLIFYING TRANSFORMERS,
\$5.50

COTO-COIL CO.

87 WILLARD AVE.,
PROVIDENCE, R. I.

THE FOLLOWING DEALERS CARRY OUR APPARATUS—CALL IN AND SEE THEM

SOMERVILLE RADIO LABORATORY
Somerville, Mass.
WHITEHALL ELECTRIC CO.
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Providence, R. I.
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RADIOELECTRIC SHOP CO.,
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Valparaiso, Ind.
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WESTERN RADIO CO.,
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ALTADENA RADIO LABORATORY,
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EVERYTHING *Radio!*

WE are authorized jobbers of the following companies:

Radio Corporation
Westinghouse
A. H. Grebe
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PHILADELPHIA WIRELESS SALES CORPORATION

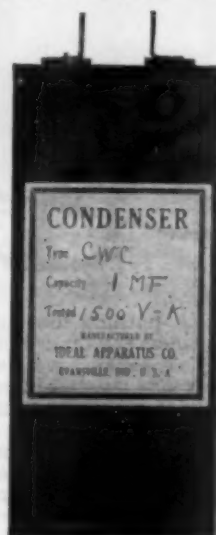
Jobbers and Dealers in Radio.



1533 PINE STREET, PHILADELPHIA

IDEAL

FILTER CONDENSER



Type ICC

The Ideal Condensers have met with great favor in radio circles throughout the country, all because of their super-efficiency.

Recently designed to stand potentials of 2000 Volts without puncturing, and at no increase in price.

These attractively priced condensers may be obtained from any of the dealers listed below. They will furnish you with complete information regarding the IDEAL LINE.

1 Mfd 2000 Volt Condenser \$2.00
2 Mfd 500 Volt Condenser 1.50

Somerville Radio Lab., Boston, Mass.
Benwood Company, Inc., St. Louis, Mo.
Pitt. Radio & Appl. Co., Pitts., Pa.
Hemple Electric Co., Omaha, Nebr.
Klaus Radio Co., Eureka, Ill.
Standard Radio Co., Los Angeles, Calif.
Nola Radio Co., New Orleans, La.
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T & H Radio Company, Anthony, Kansas
Wireless Mfg. Co., Canton, Ohio
Northern Radio Co., Seattle, Wash.

C-W CATALOG FREE
IDEAL APPARATUS COMPANY
EVANSVILLE,

"9XAH" INDIANA "9XAH"



Enjoy Wireless Music In Your Home

Hear, in your own parlor the marvelous wireless music, the prominent speakers, market reports and latest news before it is even on the press.

Get all this free entertainment and enlightenment when you want it without stirring from your fireside by installing an inexpensive receiving outfit and a

STROMBERG-CARLSON RADIO HEAD SET

The No. 2-A Radio Head Set comprises four distinct units; two Receivers, Head Band and 5 foot Cord

The Receivers

Receivers are equipped with a one-piece bipolar permanent magnet, of high grade magnet steel; provided with phenol fiber spool heads, slotted soft iron pole pieces, corrosion proof diaphragm, enameled copper wire coils. All parts are encased in a receiver shell of cast non-magnetic insulating material, that is unaffected by either moisture or temperature changes. Each coil is wound to 500 ohms. The coils are connected in series. This gives a combined resistance of 2000 ohms for the 4 coils of a No. 2-A Radio Head Set.

The Head Band

A head band is furnished of the spring wire type, covered with heavy brown webbing, correctly shaped, light in weight and comfortable to the operator. Knurled thumb screws are provided on both ends to permit locking the adjustment after it is once fitted to the head. Exposed metal parts are nickel finished. Another feature of merit, in regard to the design of this head band is a provision for separating the receivers which permits two observers listening in on a circuit simultaneously with but one Stromberg-Carlson No. 2-A Head Set.

The Cords

Each No. 2-A Radio Head Set is equipped with a 5-ft. brown silk, moisture proofed, receiver cord which is forked in two branches, one branch for each receiver. This forked construction permits two persons to use the head set simultaneously when desired—a feature of great convenience.

PRICE \$7.50

**Stromberg
Carlson Telephone Mfg.
Co.**

Send me your free
bulletin 1029 - Q
describing your No.
2-A Radio Head Set.

Mail coupon for booklet 1029-Q describing these Radio Head Sets
Stromberg-Carlson Telephone Mfg. Co.

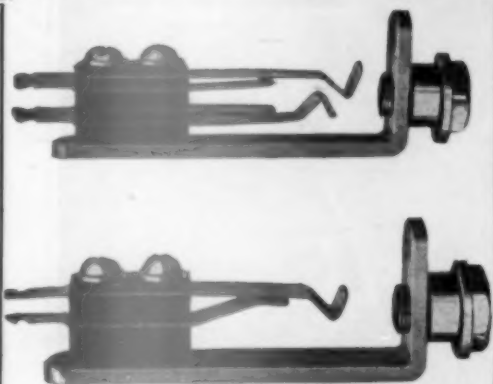
ROCHESTER, N. Y.

Branches at Chicago, Kansas City, Toronto.
Address nearest Office.

Name

Address

FIRCO JACKS



FIRCO Jacks were not offered until our engineers were assured they had produced the best Jack on the Market. They are now working on some very radical innovations in Firco products, which will be announced in an early issue of this magazine.

These Jacks have heavy Sterling Silver Contacts, Special Alloy nickel-silver springs, giving highest resiliency. Single and Double Circuit closed. Single circuit open. Three spring and five spring automatic filament control.

FIRCO BULL DOG PLUGS

"The harder you pull, the tighter it grips"

Used with Firco Jacks, the one plug that you DO NOT need a screw driver or soldering iron to connect.

Immediate delivery through your local dealer.

John Firth & Co.

18 BROADWAY, NEW YORK

Install this RTS Standard Detector Panel



Front of Panel

ONLY \$5.95

Assembled
(Without tube)

Prepaid by
Insured
Parcel Post



Back of Panel

RTS

Here is a correctly designed panel made of best grade Formica. Its signal strength is unequalled by any other tested in our laboratory. The exclusive use of silver plated wire greatly increases its efficiency.

We guarantee the RTS Detector panel to be exactly as represented and will refund your money if you are not satisfied.

Order TODAY before the price goes up.

RTS BUSHING LEVER

This Bushing Lever is well designed and beautifully finished. The knob is the well known Marconi type. Spring lever is $1\frac{1}{4}$ " long with ground ends insuring smooth adjustment. A guide bushing raises the lever to proper height for all switch points.

PRICE 60c.

New Catalog and Signal List

Send today for new illustrated catalog which also gives list of signal abbreviations.

RADIO TESTING STATION

Dept. R-4, Sturgis St.

BINGHAMTON, N. Y.

FROM CAT WHISKERS UP—

We can supply everything that's best in Radio. 1 or 101 of any article to user or dealer. Same day shipments.

Inquiries are welcome



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WESTINGHOUSE MURDOCK
RADIO CORPORATION
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AT EAST PITTSBURGH, PA.—NEXT DOOR TO KDKA



Does Your Hand to the Knob Spoil Your Tuning?

You can Eliminate by sending 50c. for One, or \$1.00 for Three Sets of well-made Parts, Post paid, to equip your Instruments in a Few Minutes and Not change their Appearance.

State diameter of your dials.

RADIO LABORATORY

259 Thomas St.

West Haven, Conn.

Another



Achievement

The TELMACOPHONE

Here is the height of Telmaco perfection. Equipped with Baldwin Type C Unit, Inverted horn, reflected tone. Equal to any other horn twice its length. Designed and perfected by expert acousticians. Complete in every detail.

Don't be misled into buying a loud speaker offered for less, and expect satisfaction; for a loud speaker of quality cannot be sold for less. Only after the most exhaustive tests and comparisons with the other loud speakers; and only after the most thorough research, laboratory tests, and field demonstrations has the Telmacophone been perfected, and offered now, for the first time to the public.

Telmaco Amplifiers, Receivers, Detectors, Variometers, and Variocouplers have earned a national reputation for quality, endurance and satisfaction not excelled by any other line. You can expect equal satisfaction from the Telmacophone.



*No extras to buy.
Nothing to get out
of order.*

Price
Complete \$20.00

Fully
Guaranteed

Price without Baldwin Unit,
but with cap attached, \$14.00.

We advise the purchase of the Telmacophone without unit for those who have Baldwin Unit of their own.

If you haven't our complete catalog "P", be sure to write for it now. Dealers! We are distributors for nearly all standard lines. Full discounts on the Telmacophone. Write for proposition on our complete line.

RADIO DIVISION

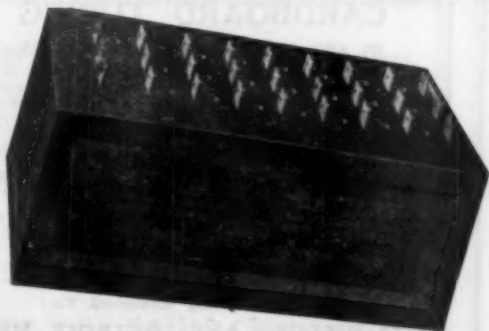
Telephone Maintenance Co.

20 S. Wells St.,

NEW ADDRESS

Chicago, Ill.

BIESMANN STORAGE "B" BATTERY



Here's What the Radio World Has Long Been Looking for. No "B" Battery to be replaced. Takes care of Detector and Amplifier.

Twenty-four cells, individually tapped permitting use of any voltage from 2 to 50 volts in steps of two volts each.

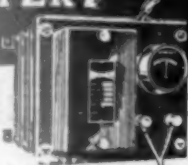
Electrolyte is semi-solid; cannot spill or leak. Container is one piece cast composition block. Highly polished and neat in appearance. Pasted type plate especially developed for Radio Service.

Battery may be charged with any vibrating rectifier by using the circuit provided with battery. Copy of instructions furnished with each battery. PRICE - \$14.00
Jobbers and dealers! Write for proposition without delay.

**RADIO DIVISION
TELEPHONE MAINTENANCE CO.**
New Address: 20 S. Wells St., Chicago, Ill.

HOMCHARGE YOUR BATTERY for A Nickle

A perfect rectifier at last, fully automatic and fool-proof in every respect. It can be operated by anyone.



The HOMCHARGER

Connects to any alternating current lamp socket, gives a taper charge—will fully charge any "A" battery over night. It is selfpolarizing. Connect your battery either way and it will always charge. Automatically disconnects battery when power is interrupted. Restarts charging when connections are restored. Adjustable for wave form, frequency and voltage. Contains only one moving and two wearing parts, lasting thousands of hours, replaceable as a unit for \$1.00. The highest charging rate, greatest efficiency, and simplest of any rectifier selling for less than \$100.00. Bulletin 628 proves it. Ask for your copy.

Manufactured in sizes for charging three or six cell batteries from both alternating and direct current circuits. Cannot injure battery—will last a lifetime—approved by underwriters—satisfaction guaranteed. For sale by all Radio, electrical and accessory dealers or shipped express prepaid for purchase price—\$18.50. (\$20 West of the Rockies.)

ATTENTION MOTORISTS:

Send for special bulletin 58 showing how easy it is to "HOMCHARGE" your battery.

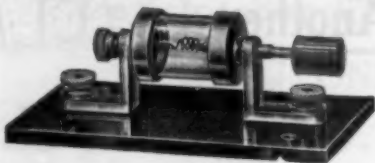
THE AUTOMATIC ELECTRICAL DEVICES CO.

127 West Third St., Cincinnati, Ohio

Canadian Distributors
POWLEY & MOODY
Ltd., Toronto



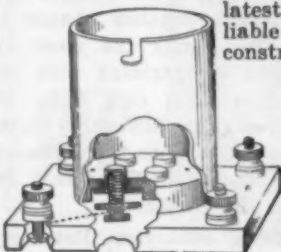
Crystal Detector Stand, No. 1200



\$2.45 Postpaid

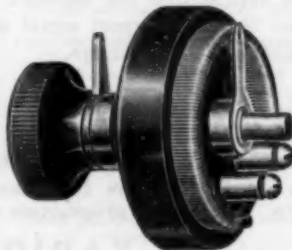
Dust-proof. No vibration. Flexible adjustment. Can be set rigidly.—Tested sensitive. Galena mounted in Woods metal sold @ 35c.

Audion Bulb Socket, No. 1150



latest in absolute reliable contacts. Study construction shown in diagram. "ON TOP OF ALL" quality, and sells for \$1.00 only. Highly nickel polished & polished black compo base.

Rheostat, No. 1175



is constructed with metal bearing for shaft, therefore more durable than others. Designed for use on panel or table. Resistance 5 ohms, \$1.00 postpaid.

CONTINENTAL ELECTRIC CO.

117 East 129 St., New York, N. Y.

Get our prices for Switch Points, Binding Posts and other parts.

THE RADIO ENGINEERING CO.

formerly

New England Radio Engineering Co.

Design and construction of special Radio Apparatus, complete installation of receiving and transmitting equipment.

Consulting service on Amateur problems with special attention to tube work.

Send 2c. stamp for bargain list.

380 LaGrange Street
BOSTON 32, MASS.

CARDBOARD TUBING

IN ANY LENGTH UP TO 28 INCHES

	Per in. or Fraction	Per Ft.
2 1/4, 3 and 3 1/2 in. diameter	3 1/2c	30c
4 and 4 1/2 in. diameter	4c	35c
5 in. diameter	4 1/2c	45c
5 1/2 and 6 in. diameter	5c	50c
2 1/4, 3, 3 1/2, 4 in. diameter have 1/8 in. wall;		
4 1/2, 5 and 6 in. diameter have 1/4 in. wall		
Postage extra; shipping weight 1 lb. per ft.		
NO stamps accepted on orders.		

MICHIGAN RADIO CO.

(Formerly Jeffery Crawford Co.)

2173 HILLGER AVE., DETROIT, MICH.

Price \$12.00 F.O.B. N.Y. City



Listen to the Concerts, News and Dance with a KING "AM-PLI-TONE."

Just slip your head phones on the "AM-PLI-TONE" and you and your friends will be SURPRISED.

Polished Cast Aluminum Body with Nickle Plated Base and Horn. No sheet Metal is used, the "Tinny" Sound is Left Out. The VOLUME is DOUBLED because TWO head phones are blended into one POWERFUL tone.

A big hit—a big seller and immediate deliveries. Dealers and distributors what more can you ask? Write today for territory—KING "AM-PLI-TONE"

82 Church St., New York City

NOTICE: All infringers of this device will be vigorously prosecuted.



Dept. R.
MILLDALE, CONN.

RADIO PANELS—

Marked off, drilled, grained, buffed. Large holes cut for meters. Send drawing with exact dimensions for estimate. We guarantee quick service, accuracy and satisfaction.

RADIO PANEL SHOP

1103 S. Third St., Evansville, Ind.

SPECIAL PRICES THIS MONTH

On Grebe, Clapp-Eastham and
Amrad Sets

MASSEY RADIO COMPANY

The Radio Store, Winchester, Va.

WIRELESS TELEPHONE AND RADIO APPARATUS (Complete Sets)

CLARK & MILLS ELECTRIC COMPANY ELECTRAGISTS

75 Newbury St., BOSTON
Tels. Back Bay 365 & 366 & 8296
1444 Massachusetts Ave., CAMBRIDGE
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RADIO CONSTRUCTION CO.

Manufacturers of all kinds of Wireless Telephone and Telegraph apparatus. Panel drilling and engraving a specialty. Binding Posts, stops, switch points, nuts and screws of all sizes.

42 Maverick Square
Winthrop Block East Boston, Mass.

SHREVEPORT

THE HEART OF THE FIFTH DISTRICT
We stock leading makes of—

RADIO APPARATUS

MAIL ORDERS A SPECIALTY

Shreveport Radio Supply Co.

P. O. Box 600, 222 Texas St., Shreveport, La.

CROSLEY

V-T SOCKET



PRICE

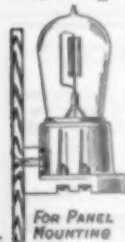
60¢

*Better—
Costs Less*

Now the CROSLEY V-T Socket has been adopted by several of the leading manufacturers of radio apparatus, as standard in their products. There are many good reasons for this universal acceptance. Here are some of them.

The Crosley V-T Socket is made in one piece, of porcelain—the very same material that is used in the base of vacuum tubes—consequently it is of high dielectric value. The bayonet catch is imbedded in a heavy wall of porcelain, that is for all purposes, unbreakable. Soldering irons will not melt this socket and it is ideal for power tube work.

The design positively eliminates all possibility of short circuiting filament across high voltage B Battery.



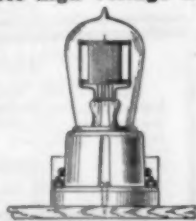
FOR PANEL
MOUNTING

Almost every leading jobber and dealer in radio equipment, the whole country over, is handling the CROSLEY V-T Socket—NOW. The demand is heavy and its popularity is sweeping the country.

The low price needs no apologies—large production alone makes it possible.

Everyone now says the CROSLEY V-T Socket is "Better—Costs Less."

Buy from your Dealer. He has it or can get it for you.



FOR BASE MOUNTING

To the few Jobbers and Dealers who are not handling the CROSLEY V-T SOCKET, we make the suggestion to get in line.

CROSLEY MANUFACTURING COMPANY

Radio Dept. Q-9,

134

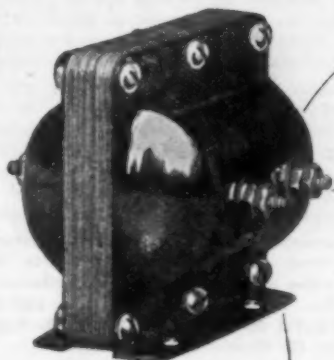
Cincinnati, Ohio

ALWAYS MENTION QST WHEN WRITING TO ADVERTISERS

Announcing the **CROSLEY SHELTRAN** *Audio Frequency Amplifying Transformer*

RATIO **9 TO 1**

*Completely
Shielded*



HIGH grade materials and excellent workmanship, combine to give the CROSLEY SHELTRAN the great efficiency and attractive appearance so often lacking—except in the most expensive transformers. At the same time, we incorporated in the design of the SHELTRAN all the characteristics that are necessary to obtain maximum amplification from the modern vacuum tubes. These tubes with their high amplification constant, operate most effectively at large fluctuations in the grid potential. The ratio of turns is 9 to 1.

The CROSLEY SHELTRAN has a base area of $1\frac{1}{4}$ in. x $2\frac{1}{4}$ in., net weight $12\frac{1}{2}$ oz. The overall length is $2\frac{1}{2}$ in., overall height $2\frac{1}{4}$ in. and the overall width is $2\frac{1}{4}$ in.

Price complete, ready to mount....\$4.00

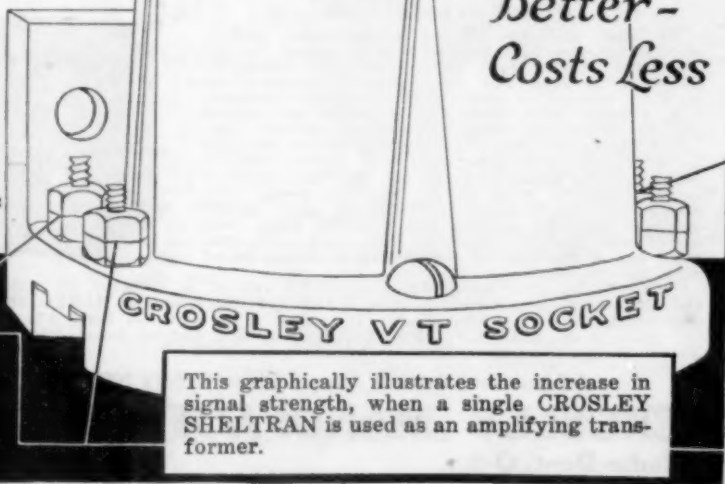
*Jobbers and Dealers:
Order now for early deliveries*

**CROSLEY
MANUFACTURING
COMPANY**

Radio Dept. Q-9
Cincinnati, Ohio

\$4.00

*Better-
Costs Less*



This graphically illustrates the increase in signal strength, when a single CROSLEY SHELTRAN is used as an amplifying transformer.

Satisfied Users of HARKO SENIORS

have written this advertisement

Read what expert Radio men think of the CROSLY HARKO SR.



The HARKO SENIOR was developed to supply the demand for a low-priced, efficient receiving outfit, having a range of from 150 to over 600 meters, thus bringing in on the average amateur antenna—amateur stations, radio telephones and commercial stations, operating up to and including 600 meters. Ship and stations on the Atlantic Coast are easily copied in Cincinnati. Radio telephone concerts and voice, from Newark, New Jersey and other New Jersey phones in addition to Pittsburgh and other phones, are regularly copied in Cincinnati. It is just the thing for receiving radio telephone concerts.

This instrument is a combination tuner and audion detector. It consists of a tapped inductance, a CROSLY VARIABLE CONDENSER, CROSLY Model "A" Rheostat, CROSLY V-T SOCKET, CROSLY GRID CONDENSER and Leak. The hook-up is special—of our own design and is non-regenerative.

Parts are mounted on panel of formica or other similar dielectric composition. The whole thing is mounted in a mahogany finished cabinet 11½ inches wide, 6 inches high and 4½ inches deep.

This set is very efficient. The price is remarkably low.

The HARKO SENIOR is sold complete as described without tube, "B" Battery, "A" Battery or phone, as is usual with such apparatus.

PRICE\$16.00

"Have just hooked up the Harko Senior and Two-Step Amplifier. Detroit came in like a house-a-fire." Ray-Di-Co Organization, Chicago, Ill.

"Have received the Harko Senior. On test this set picked up the Radio phones at Pittsburgh and Detroit Tuesday night. On the whole we are pleased with the set." Ashtabula Radio Sales Co., Ashtabula, Ohio.

"I received your Harko Senior today and we gave it a trial and considering the simplicity of operation, it worked beyond our expectations. In conjunction with a Two-Stage Amplifier, we heard WBL, WJZ, KDKA and others. They were not loud but were quite clear and the most noticeable thing about it, there was no C.W. carrier audible." Romeo Radio Shop, Romeo, Mich.

"We received the Harko Senior Receivers. We tried one of them out and had no difficulty in picking up Detroit voice and music, also from Milwaukee and Pittsburgh, Pa. They seem to work O.K., and we think they are wonderful for the money." H. B. Rodecker, Washington C. H., Ohio.

"Harko Senior O.K. We indorse same and back it with our own guarantee. Speaks for itself. Using one-step Amplifier and Harko Senior were able to hear Pittsburgh, Chicago, Detroit and NOF." Hoopes Radio Shop, Hoopes, Ill.

"We are in receipt of your Harko Senior Receiver and are certainly getting good results with it in this locality." Wright Electric Co., Scottsdale, Pa.

"Last evening late I cut in and got Denver fine on the Harko Senior. Think I will have some business in a short time when the weather gets alright again." H. T. Hain, Lock Box 262, La Crosse, Kansas.

"We received your set and found it to receive all the musical concerts from KDKA and the like with the commercials coming in strong on 600 meters. It is a distance of nearly 800 miles from Pennsylvania as near as we can figure." Androscoggin Radio Supply Co., 42 Blake St., Lewiston, Maine.

THE CROSLY TWO STEP AMPLIFIER

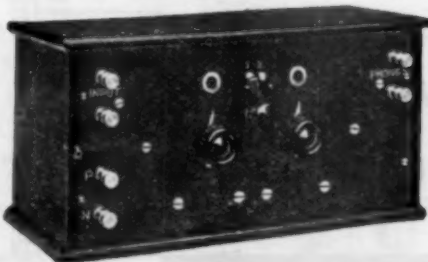
"Better — Costs Less"

To meet the demand for a moderately priced, efficient two-step Amplifier we have developed the one illustrated on this sheet. This consists of CROSLY Rheostat, Sockets and Transformers, mounted on panel of formica or other similar dielectric composition, complete with binding posts which are marked and tap switch for changing from one to two steps.

The CROSLY TWO-STEP AMPLIFIER is designed to work well with practically any audion detector hook-up. The phone posts on the detector connected to input binding posts on the amplifier panel. The phones are then attached to the phone posts on the amplifier and the positive and negative posts connected with the "A" Battery. Two leads with clips come out of the rear of the cabinet to be connected with the "B" Battery.

The CROSLY TWO-STEP AMPLIFIER cabinet is designed to match up uniformly with either the CROSLY Detector Unit, the HARKO JUNIOR or the HARKO SENIOR. The size of the cabinet of the Two-step Amplifier is 11½ inch wide, 6 inches high, 4½ inches deep.

Price of the CROSLY TWO-STEP AMPLIFIER without tubes, "A" or "B" Batteries, complete as shown in the illustration, is.....\$25.00



Jobbers and Dealers Should Place Orders NOW for Early Deliveries

CROSLY MANUFACTURING COMPANY

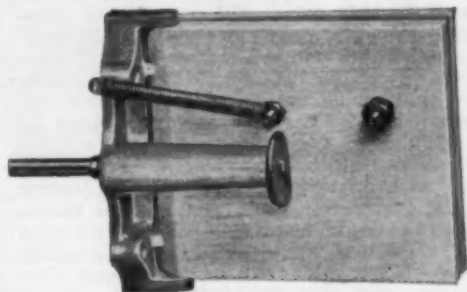
Radio Dept. Q-9,

Cincinnati, Ohio

Crosley Variable Condensers

"Better—Cost Less"

Variable Condensers that do the work—that's the only kind we make. The Auto Electric Service, of Rockport, Maine writes:—"Our station has your Condensers in use and we get KDKA with a Two Step Amplifier loud enough to hear in the next room with the phones on the table. This we could not do with any other make of Condenser." It's the same story everywhere they are used.



MODEL "C"

The principle of this instrument needs no introduction or explanation—it is made right and it works. This model differs from the other CROSLY models in the size of the plates, the material of which they are made and the capacity. The plates are made of porcelain, ground true on the contact surfaces before the copper and mica are applied. The capacity is conservatively rated at .001 Mf. and the extremely low capacity makes it ideal for use where a condenser is specified up to .001 Mf. capacity. It is especially recommended for radio phone work as it will not shower or break down, tested under a thousand volts. Furnished ready to mount on panel or in a cabinet, with $\frac{1}{4}$ in. shaft standard or $\frac{1}{8}$ in. shaft optional.

Price each, without knob and dial.....\$2.25

Same, with knob and dial..... 2.75

Same, with knob and dial and mounted in mahogany finished cabinet, complete with binding posts 3.50

CROSLY KNOBS AND DIALS



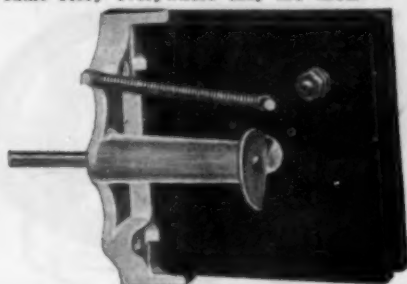
Extremely well made of brass, stamped from a solid piece and finished with a high grade, durable black laquer. The figures stamped in the dial and enameled with white enamel. Overall diameter of dial 2 $\frac{1}{4}$ in. Furnished for $\frac{1}{4}$ in. shaft, standard or $\frac{1}{8}$ in. optional.

Price, Knob and Dial complete

50 cents

Most Jobbers and Dealers are now carrying CROSLY VARIABLE CONDENSERS. If yours does not, send order to us direct, with your dealers name and address. We will ship prepaid.

CROSLY MANUFACTURING COMPANY
Radio Dept. Q-9,
Cincinnati, Ohio



MODEL "B"

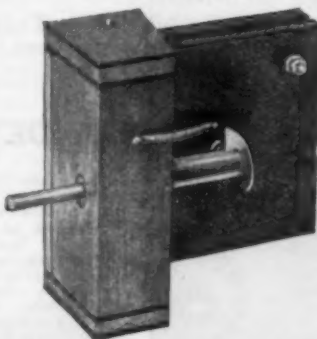
Like all CROSLY VARIABLE CONDENSERS the Model "B" has no appreciable body or hand capacity and is easier to tune in C.W. and L.C.W. than any other condenser made. Conservatively rated capacity, .0005 Mf., but tests in the Laboratories of one of the leading universities of the country have shown the maximum capacity of this model to never be less than .0008 Mf. and frequently running better than .001 Mf. The Model "B" CROSLY Variable Condenser has best quality laminated wood plates and a die cast metal frame. Extremely neat in appearance. Furnished, ready to mount on panel or in a cabinet, with $\frac{1}{4}$ in. shaft as standard and $\frac{1}{8}$ in. shaft optional. This model occupies a space on the panel of 1 $\frac{1}{2}$ " x 3 $\frac{1}{2}$ " and 3 $\frac{1}{2}$ " deep.

Price, each without knob and dial.....\$1.75

Same, with knob and dial..... 2.25

Same, with knob and dial and mounted in mahogany finished cabinet complete with binding posts 3.00

MODEL "A"



This instrument needs no further introduction to radio men. Thousands have been sold and are now in use. The conservatively rated capacity is .0005 Mf. and like the other CROSLY models, it is a universal condenser for C.W. and other transmission work as well as receiving. Every CROSLY Variable Condenser

is tested to withstand 1000 volts before shipment. Just try this test on most air condensers providing you have no further use for the instrument. The frame of this model is made of wood; the plates are high grade laminated wood which function perfectly under all conditions.

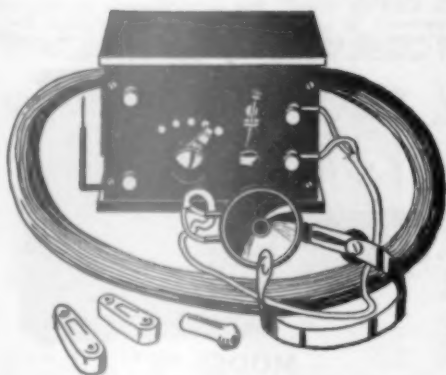
Price each, without knob and dial.....\$1.25

Same, with knob and dial..... 1.75

Same, with knob and dial and mounted in mahogany finished cabinet, complete with binding posts 2.50

CROSLEY RADIO APPARATUS

"Better—Costs Less"



HARKO RADIO RECEIVER

The most compact and complete efficient crystal receiving outfit on the market. Designed for the amateur who wishes to get started in this wonderful game. The illustration shows complete outfit ready to hook to aerial, fones and ground wire. Will tune from 200 to 600 meters, bringing in spark, voice and music with average amateur antenna. NAM, Norfolk, Va. and ships at sea copied in Cincinnati.

A wonderful little instrument. Price complete with battery, interrupter for testing crystal, instructions, etc. \$9.00. One thousand ohm single head set, 125 ft. antenna wire, insulators, etc. \$6.00 extra. Complete outfit \$15.00. If your dealer cannot furnish, we will ship direct prepaid.

Crosley Radio Storage Battery

The CROSLEY RADIO STORAGE BATTERY has been developed as a special "A" Battery for radio work and is especially designed to take care of vacuum tube filament current and other purposes where six volts are required.

Do not compare the CROSLEY RADIO BATTERY with the three, five or seven plate lighting batteries generally offered for radio work. The CROSLEY RADIO BATTERY is a standard 11 plate, heavy duty automobile type battery for radio work. It has greater than 80 ampere hour charging capacity. The size of the CROSLEY RADIO BATTERY is 7 5/8 in. long, 7 15/16 in. wide and 9 in. high, overall.

Every battery is shipped fully charged and ready to hook to your vacuum tube or tubes.

Price each, fully charged\$17.00



CROSLEY DETECTOR UNITS

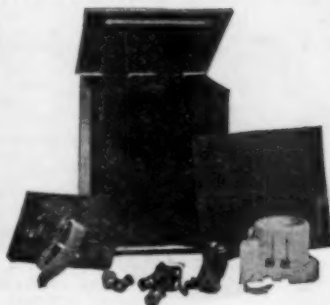


These are furnished in two ways:

Completely wired and mounted as shown on the left, or knocked down as shown on the right. Mounted—everything ready to hook to your set. Suitable for many different hook-ups. Formica panel: mahogany finished cabinet. Matches up with the CROSLEY TWO STEP AMPLIFIER.

Price, completely assembled, as shown on the left.....\$7.50

Price of all parts, including formica or other panel or high grade dielectric composition, not drilled as shown on the right\$6.00



CROSLEY MANUFACTURING COMPANY

Radio Dept. Q-9,

Cincinnati, Ohio

--More CROSLEY RADIO PRODUCTS

"Better--Costs Less"

Crosley Cabinets



The tendency in the radio field today is to put apparatus in cabinets not only for appearance's sake, but as a protection from dust, dirt, atmospheric conditions etc. Realizing the demand for attractive stock cabinets of various

sizes, we are building them in quantities in our large wood working plant. These cabinets are all uniform in style. The panels are rabbeted in to the front. As the outside dimensions and inside dimensions are either larger or smaller than the panel itself, we show panel size and also inside dimensions. Prices quoted do not include the panels.

Wood used is either gum or mahogany in dark antique or red mahogany finish or in quartered oak in natural or antique finish. Specify type of wood and finish in ordering. Lids or tops are hinged. Sizes and prices are:

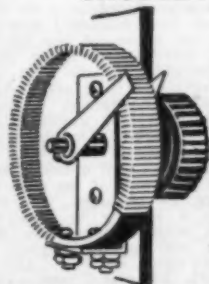
For Panel Size	CABINETS Inside Dimensions			Mahogany or Quartered	
	High	Wide	Deep	Gum	Oak
6x7	5 1/2"	6 1/2"	7"	\$2.50	\$3.85
6x10 1/2	5 1/2"	10"	7"	2.75	4.40
6x14	5 1/2"	13 1/2"	7"	3.30	5.55
6x21	5 1/2"	20 1/2"	7"	3.90	7.30
9x14	8 1/2"	13 1/2"	10"	3.70	6.80
12x14	11 1/2"	13 1/2"	10"	4.40	6.80
12x21	11 1/2"	20 1/2"	10"	5.25	10.60

Cash must accompany order. No C.O.D.'s. We pay transportation charges.

FORMICA PANELS

We can furnish genuine formica panels 1/8" thick, cut to the following dimensions: 6x7; 6x10 1/2; 7x9; 6x14; 7x12; 6x21; 7x18; 9x14; 12x14; 14x18; 18x21. Price of panels—2 1/2¢ per square inch. For odd sizes order the next largest size; we will trim. We pay postage.

CROSLEY RHEOSTATS



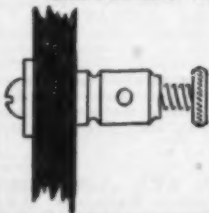
Complete with knob, pointers, etc. as shown in illustration. Our unique construction permits mounting on panel of any thickness up to and including 3/4": non-corrosive resistance wire.

Model "A"—overall diameter 1 1/2". Resistance 7 ohms, one ampere without heating. Suitable for detector or amplifier tubes. Price 60¢ each.

Model "B"—Resistance 4 ohms; will carry 3 amperes without heating. Suitable for detector, where very

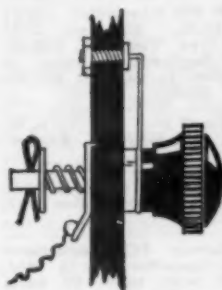
accurate adjustment is required and for 5 watt power tubes. Price \$1.25.

CROSLEY BINDING POSTS



Barrel 3/8" x 1/4". Not too small nor too large, just the right size.

Nickel plated. Complete with base screw and washer as illustrated. Price, 8¢ each or 90¢ per dozen.

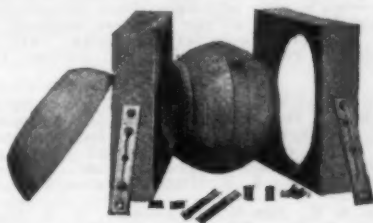


CROSLEY TAP SWITCHES

Note unique construction assuring constant tension. Composition knob, nickel-plated switch arm and bushing. Note stationary washer with soldering lug, making possible buss wire connection. Price 40¢ each. Better—Costs Less.

SWITCH TAPS for above, brass nickel-plated, complete with brass nut, 8¢ each, 30¢ per dozen or \$2.50 per hundred.

CROSLEY VARIOMETER PARTS



This set consists of two stators, one rotor, the necessary hardware shown in the illustration. Shaft for knob and dial is 1/8" diameter. The wood parts are furnished either in poplar or mahogany.

The average radio man has his own ideas about the kind of wire and the number of turns that he wishes to use, depending upon its purpose, so we leave that to the purchaser. The operation of winding and setting up is very simple, but the parts that we list are difficult for the amateur to make.

They are made in our own large wood working plant on special automatic machinery that make possible very accurate quantity production.

Price of Variometer parts, described above, made of poplar wood, is \$1.50 (including wood parts and hardware).

If wood parts are made of mahogany \$1.75.

If winding form is desired, it can be used for winding one or more variometers. Price is 30¢ additional.

CROSLEY VARIOCOUPLERS



CROSLEY VARIOCOUPLERS consist of formica tube, rotor and brass hardware. It is made with the same care and accuracy as the CROSLEY VARIOMETER.

Price, complete as shown in the illustration, not wound or assembled, \$1.50. Rotor only 40¢.

If your dealer does not handle any of the above parts, you may order direct. We will ship prepaid. Dealers and Distributors: Every item shown above should be in your stock. Write for proposition.

Crosley Manufacturing Company
Radio Dept. Q-9, Cincinnati, Ohio

CLASSIFIED ADVERTISEMENTS

Five cents per word per insertion, in advance. Name and address must be counted. Copy must be received by the 10th of month for succeeding month's issue.

WANTED: 500 Volt, 100 Watt Generator. State all particulars. R. H. Beaumont, Jr., Radnor, Pa.

FOR SALE: General Radio type 145 wavemeter, (new) \$35.00; Amrad wavemeter, \$6.00. 43 plate #167 Murdock condenser. Station type Vocaloud, \$24.00. Packard 1KW transformer. Regenerative tuner in cabinet, \$22.00. 2-step amplifier in cabinet, \$26.00. Arthur L. Walser, Cheesaning, Mich.

SELL: Regenerator \$30, detector 2 step \$25, 1/4 K.W. set \$25. Inquire J. Pascal, 85 Sherman Avenue, Staten Island, N. Y.

SELL: Treco all-wave tuner, detector panel, \$70.00; or Treco regenerative, detector, \$40.00. Box 967, Ogden, Iowa.

C.W. STUFF: Tuska Transformer \$13, Inductance with clips \$5, rheostat \$2.50, ammeter \$5, 1/4 mfd. condenser \$1, 2 burnt out 5 watt tubes \$2 each, P. Lindauer, 1014 11 St., Lorain, O. 8CER.

3J1 Is Calling! Please Stand By! Calvert's Short Method of Learning the Continental Code. Printed on highly-glazed cardboard 7x16 1/2 inches. 35c brings it to you with a copy of International Abbreviations, free! Positively, one of the simplest methods ever devised. This issue only at this price. 3J1 Now Signing Off. 1 Pay Postage. G. W. Calvert, Lansdale, Pa. 3J1.

FELLOWS HERE'S A BARGAIN: 9DP will be sold. 1 K.W. Spark Transmitter, Switch board, Paragon, Universal Arc Receiver, Two step, Baldies, storage batteries, aerial, etc. \$340.00 takes all radio apparatus I have. Will sell parts separately. Write for list and description. E. H. Hartnell, Salem, Wisconsin.

WANTED: 6 V., 350 V. Dynamotor. A. J. Higson, 84 Romaine Avenue, Jersey City, N. J.

MUST SACRIFICE Super Regenerative: Perfect phone reception, 180-600 meters Turney Regenerative, audio and crystal detector, two stage amplification, external tuner and tickler connections, three condensers with verniers, vernier detector rheostat, Formica panel, telephone switch controls, jacks. Complete with bulbs, B battery, Connecticut phones. \$75 First money order takes. Arthur Osborn, 311 E. Daniel, Champaign, Ill.

SELL: Efficient 1/4 K.W. Transmitter, complete; including Dubiller Condenser. Enclosed Rotary and Marble Control Panel for best offer. Clarence M. Voll, 49 Pawnee Parkway, Buffalo, N. Y.

COMPLETE STATION EQUIPMENT OF 8BQ: 1KVA transmitter with D.X. record. Grebe CR-2, Det. 2 stage with all accessories. Very reasonable, guaranteed. H. Walleze, Danville, Penna.

WANTED: 2 Western Electric V.T.1's. J. Weiss, 219 East 83d St., New York City.

1/4 K.W. TELEFUNKEN 500 cycle transmitter mounted heavy engraved bakelite panel, aluminum angle frame complete with meters, key rheostat, self-excited generator and AC motor mounted on rubber, spare gaps, condensers, \$300.00. Radiophone on bakelite panel, with two new VT2s, transmitter, switches, condensers, dynamotor 30-350 volts \$50.00. All F.O.B. Seattle. Fotos. Obradovic, 5103 Meridian, Seattle.

AERIAL WIRE—100 foot coils; 7 strands #22 Hard Drawn Copper 90c; Tinned \$1.50; No. 14 Hard Drawn Copper 55c; Postage weight 2 pounds per coil. Chas. L. Manning, 1558 Miller Street, Utica, New York.

BARGAIN: One Kilowatt Type H-1 Acme, panel mounted \$25. Benwood Aluminum Enclosed Gap and R & M 3400 RPM Induction motor \$30. Both \$50. Guaranteed A-1 Condition. Still being used. Radio 9VZ, C. W. Kleman, 2011 Carrard Street, Covington, Ky.

FOR SALE: 2 C. D. Tuska Variometers, one Radio Shop coupler and dials. Price \$15. H. A. Williams, 204 S. Third, Bozeman, Montana.

AMATEURS—Write for list of receiving apparatus. Good condition. B. Dudley, 4909 Fletcher St., Chicago.

SELL—1 KW Type T2 Thordarson \$24; oil immersed condenser \$15; Benwood gap with standard motor \$15; Murdock line protector \$4; Acme anti-light-blinker \$5; heavy United Wireless 10 amp. key \$4; Holtzer Cabot 3000 ohm phones, like new \$7. All good condition. First money order takes all or sold separately. Paul D. Mohr, Emaus, Penna.

EDISON B BATTERY ELEMENTS. Make your own. Can be recharged and lasts for years. 200 ampere hour A batteries, guaranteed, \$35.00. Harry Morrell, 52 Goffe St., New Haven, Conn.

BARGAIN: One K.W. Thordarson Flexible transformer \$15. Thordarson Oil Condenser \$15. Thordarson Oscillation Transformer \$5. Gap motor with Thordarson disc \$6.00. Kernel aerial ammeter \$5. Overland Key \$3.00. All guaranteed. J. Pinkston, Valdosta, Ga.

SELL: Duck Co.'s one-step with Federal—New—\$10.00 prepaid. J. D. Blitch, Lexington, Va.

RADIOTRON DETECTOR \$4.00. Amplifier \$5.00, new tubes. Both \$8.75. Prepaid. Wesley Robinson, Jr., St. Marys, Georgia.

WE CAN SHIP IMMEDIATELY—Burgess 22 1/2 volt "B" Batteries \$3.00 and the following Rhamstine products—Adapt-O-Phone \$12.00, Amplifying Transformer \$3.50, Socket \$1.00, Plug and Jack \$1.50, Jack only \$0.85. Postage prepaid. The L and B Radio Shops, Dept. Q, 6195 McMillan Ave., Detroit, Michigan.

FOR SALE: DeForest RS200 utility receiver \$20.00, 3 circuit regenerative detector and one step \$50.00, 1/4 HP 1400 R.P.M. 25 cycle motor \$15.00, 1/10 HP 3400 R.P.M. 60 cycle new \$19.00 and new 1/4 HP 1750 R.P.M. 60 cycle motor \$14.00. Thomas A. Reid, 8CLD, Springfield, Ohio.

WANTED: O.T., changeover switch, etc. 1CUK, J. W. Packard, Canton, Mass.

C.W. TRANSFORMERS Unmounted. 200 watt with one 550 volt secondary \$6.00; with two 550 volt secondaries \$8.50. All have 350 volt taps. Postpaid. Money back guarantee. Milton Zumpe, 1332 Mishawaka Ave., South Bend, Ind.

BUILD YOUR OWN WIRELESS Telephone and Musical Receiver, Don't Wait for a Set. We Hear Chicago, 900 Miles, Fine on Good Nights. Pittsburgh, Newark and New York Come in Good and Loud—You Can Do the Same on a Single Bulb. There is Radio Music in the air each evening, and the living voices of the artists can be reproduced in your own home and enjoyed by you and your friends. Are you satisfied with your receiving set or would you like to build one that will receive over 6,000 miles on a single bulb and quit experimenting? One that will be equal to any regardless of claims and price—with which you can hear Honolulu, California, German, South American, French and English stations and practically all of the high powerful foreign and domestic stations, as well as amateur stations as far west as New Mexico, and the phone and music. Anyone can assemble this outfit and wire it up, and the remarkable ranges that may be obtained will surprise you. Why not make a set up to date and efficient? Don't experiment with unknown circuits. We will promptly mail you our sample diagram of a complete short and long wave receiver, 175 to 20,000 meters, together with complete instructions for wiring and assembling, price of each part and where they can be bought, leaving nothing to guess about, on receipt of fifty cents in coin or stamps. Here is a diagram no one can afford to be without. Virginia Novelty Company, Desk A, Martinsburg, West Va.

1000 VOLT 750 WATT D.C. generator excellent condition \$70. C.W. transformer 500 watt 10 and 500 volts \$10. Twin cylinder Indian motorcycle engine slightly used \$40. Philip Stout, 1621 Riverside Drive, Knoxville, Tenn.

STOP! LOOK! and ACT! V.T.'s ACCESSORIES! With each of the listed tubes Radiotron U.V.200 \$5.00 and A.P. Moorhead detectors \$5.00; Radiotron

U.V.201 \$6.50 and A.P. amplifiers \$6.50; We will supply free of charge your choice of either of these six premiums—Latest FADA rheostat \$1.00, No. 810 Remler Smooth Running Rheostat \$1.00, Paragon V.T. socket \$1.00, Murdock V.T. socket improved contact type \$1.00, DeForest V.T. socket \$1.00, FADA panel mounting V.T. socket Bakelite base \$1.10. Either of the Federal single, closed or double circuit jacks listed respectively at \$0.70, \$0.85 and \$1.00 will be given as premiums with each Federal 226W amplifying transformer \$7.00 or R.C. of A. U.V.712 \$7.00 and the U.V.1714 Radio Frequency Amplifying Transformer. FADA 5 ampere Nichrome power rheostats \$1.35 or R.C. of A. U.R. 542 Porcelain V.T. socket supplied free of charge with each \$8.00 U.V. 202 power tube or A.P. Moorhead 5 watt Type C power tube \$7.50 for C.W. or Radiophone transmission or power amplification. We absolutely guarantee the foregoing apparatus. Only new and high grade equipment carried in stock. Unsatisfactory goods subject to return within five days. Twelve hour service. Postage and insurance prepaid by us, thereby saving time and money. Remember us. The Kehler Radio Laboratories, Dept. Q. Ahilene, Kansas.

RADIO APPARATUS built to order. Send diagram and description for estimate. Amplifiers a specialty. C. C. Pidgcon, 1343 Clifton St., Washington, D. C.

BKUMA YRLSBUG Beginners do master Wireless Code thirty minutes to two hours after limited practice do pass Govt. examination obtain license. Forty page Booklet information and reports from 240 successfully self instructed beginners mailed for ten red stamps. Dodge, Box 210, Mamaroneck, N. Y.

Variometers \$3.00; Vario-couplers \$3.00. Immediate shipments. Benger-West Mfg. Co., 135 Cooper St., Brooklyn, N. Y.

EDISON ELEMENTS, insulators and connecting wire 10c per pair. Information given for making B batteries. E. Pierson, 728 7th St., Niagara Falls, N. Y.

WIRE SPECIAL! 1/4 lb. spools D.C.C., No. 26 Wire, 80c; 24 D.C.C. (Just the thing for your inside aerial) 100 ft. coils, 75c; 7 strand-22, copper aerial wire, 100 ft., 80c; 250 ft., \$1.80; 300 ft., \$2.25; 500 ft., \$3.50; 1000 ft., \$6.90. Send Money Order. We Pay P.P. Insurance. Star Cabinet & Radio Shop, Lansdale, Penna.

SELL: Navy type loose-coupler, \$5.00; 1 KW Packard, \$10.00; Ford coils, \$1.00 each. F. B. Hoselton, Webb City, Mo.

500 VOLT GENERATOR, \$15.00; 1/4 h.p. R. & M. Induction Motor, \$15.00; Acme 200 watt mounted CW Transformer, \$15.00; Acme 150 watt filament heater \$10.00; 2 Amrad basket balls, \$5.00 each; 80 amp Storage Battery, New, \$15.00. A. Hengelbrok, 922 Washington, Newport, Ky.

FOR SALE: \$175.00 worth of New Standard Radio equipment. Champ Clark, Anthony, Kans.

AMRAD synchronous motor, Benwood rotor, electrodes complete \$28. IPI.

REGENERATIVE RECEIVER. Combined medium wave cabinet and detector two-step. Fine on 200 meter C.W. Worth \$125, Sell \$55. Brandes Superior \$5.50, variable \$2.50, variable fixed, eighth horse induction motor \$10, crystal detector, load coil, Amrad dials, baby knife switches. Few sockets, amplifying transformers, rheostats. O. R. Wimpy, 116 Sheetz, LaFayette, Indiana.

FOR SALE: Thordarson half kilowatt Transformer, Dubilier Condenser, Benwood Rotary without motor, International Radio Oscillation Transformer, 0-5 Ammeter Dubilier Kickback Preventer. Has worked five hundred miles. Bargain at \$75. H. C. Richards, 254 Main St., Norwalk, Conn.

RECTIFIER PLATES FOR C.W. 72 square inch piece of aluminum \$0.75. 72 square inch piece of lead \$0.60. Log book, 100 pages 50 cts. Philadelphia Radio Supply, 5714 Hazel Ave., Philadelphia, Pa.

NAVY STANDARD 1/2 KW Quenched 500 cycle Panel Transmitter with automatic starter and Motor-generator, Tunes up to 952 M., good condition \$225. Marconi 1/2 KW Synchronous 500 cycle Cargo Type Transmitter with Motor-generator \$110. French 1/2 KW Field-transmitter \$47.50. Other Government Apparatus Cheap. Eaton, 1915 S. Twelfth, Phila., Pa.

DUAL GRIP CLIPS Lock to your A or B battery terminals. Can be used for tapping the circuit anywhere at one tenth the cost of plugs and jacks. Post paid, 25c each or 5 for \$1.00. Variable B batteries,

22 1/4 V., \$2.00 & \$3.00. Assorted coil springs, 75 for \$1.00. The Dual Tool Company, 12428 Euclid Ave., Cleveland, Ohio.

FOR SALE: New 25,000 volt Thordarson \$30.00. Cosradio O.T. \$12.00. Klitten gap \$18.00. All for \$58.00. Write for details. 71.N.

ALUMINUM. Absolutely pure machine cut aluminum strips for chemical rectifiers, 1/8 in. stock, 6 in. long; 1/2 in. wide 10c, 3/8 in. wide 8c. Radio Aluminum, 13 Grant St., Natick, Mass.

We have plant and equipment to manufacture complete components or parts for wireless apparatus, for distributors and manufacturers. Based on extensive mechanical experience, our production and workmanship will compete with market demands. Diamant Tool & Mfg. Co., Inc., 91-97 Runyon St., Newark, N. J.

SPECIAL RADIO BATTERY: The same as used by 2BML in Transatlantic Test, Capacity 80-Ampere hours. Case will not absorb acid, therefore will not stain floors, Price \$22.00. Neils Larsen, Riverhead, N. Y.

DETECTOR PANELS \$4.50, wood variometer not assembled \$9.50. For DX work, Tresco tuner \$5.75 each. Crystal detector \$1.75. 5 watt CW set \$25.00. West Electric V.T.2, each \$7.25. Swap 350 volt motor-generator set type Midget, new 20 watts. Other bargains, send stamps for list. Mack's Radio Shop, Ansonia, Conn.

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WANTED: Wavemeter Navy type S.E. 965 as advertised December QST page 72. Also want used Wireless course complete. C. Bramer, 2140 South Harding Ave., Chicago.

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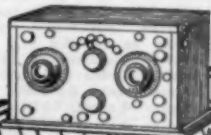


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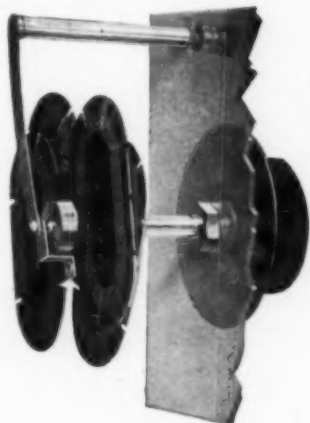
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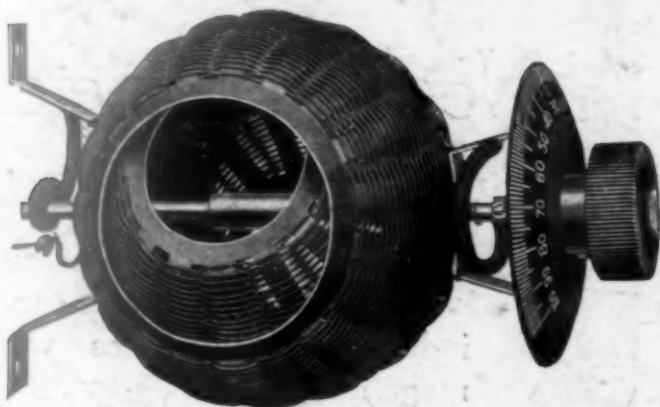
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